THE

# ELECTRICAL REVIEW.

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THE

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## MR. PARSONS ON THE PATENT LAWS.

THE Hon. C. A. Parsons's presidential address to the engineering section of the British Association was chiefly devoted to pointing out defects in our Patent Laws. That our Patent Laws are as yet by no means perfect we readily admit, but some at least of Mr. Parsons's criticisms appear to be somewhat belated. For example, when he says, "What a waste of time, expense, and disappointment would be avoided if we in England helped the patentee to find out easily what had been done previously, on the lines adopted by the United States and German Patent Offices, who advise the patentee after the receipt of his provisional specification of the chief anticipating patents, dead or alive." Mr. Parsons does not appear to be aware that the amendment which he here recommends has already been made by an Act of Parliament which will probably come into force at the beginning of next year.

Another grievance which Mr. Parsons has against the Patent Laws is expressed as follows: "Let us suppose that some inventor has the good fortune to place the keystone in the arch of an invention to add some finishing touch which makes the whole invention a complete success and valuable. Then success having been proved possible, others try to reap the results of his labour and good fortune, and as often happens, it is discovered, after laborious search, that someone else first suggested the same keystone in some long-forgotten patent or obscure publication, but for some reason or other the public were none the better for his having done so. What does the law do? It says this is an anticipation, and instead of apportioning to all parties reasonable and equitable shares in the perfected invention, it says that the patent is injured or perhaps rendered useless by anticipation, and that its value to everyone concerned is thereby diminished or destroyed." We hardly think this is in accordance with the practice of our Law Courts in Patent cases; success is always taken as a presumption of novelty in an invention. As Mr. Parsons mentioned in responding to Prof. Schröter, he himself succeeded in getting the Court to annul 100 turbine patents.

But the chief demand for amendment of the Patent Laws made by Mr. Parsons is for a great extension of the time during which a patent can remain in force. He contends that in the case of many problems to be solved by engineers no patent can give adequate protection, because the time required to make the invention a commercial success may be much greater than the 14 years allowed by the present Patent Law.

He takes as an example of an extreme case, the sinking of a shaft in the earth to a depth of 12 miles. This he estimates would take 85 years, and would cost five million pounds. Any initial patents for inventions used in sinking this shaft would have expired before a commercial result was reached, and there would be no inducement to business men or financiers to undertake the risk.

There might assuredly be some hardships in this extreme case, but it will be time to amend the Patent Law to meet it when such cases occur. At present the protection for 14 years, which may be extended in extreme cases to 28 years, appears to be ample to ensure in all cases, a due reward to the inventor and to those who invest their money in the invention.

Mr. Parsons appears to look at patents almost entirely from the inventor's point of view. He does not consider what a clog his abnormally extended patents would be to the industries of the country. It may be true, as he says, that "for every unit of capital spent by inventors and their friends on invention, they have, in some cases, received nothing back; in some cases they have just got their capital back; in some cases two or threefold, occasionally tenfold—very rarely a hundredfold. Whereas the world at large has received a present of ten thousandfold greater value than the money spent and misspent by the small band of past inventors"; but a great deal of this capital spent by inventors is spent on worthless inventions for which they no more deserve reward than for money thrown away on other foolish speculations.

If Mr. Parsons had directed a little of his attention to the criticism of the patent laws from the point of view of the manufacturer and the consumer, he would have found much better ground for asking for amendments. The Patent Act which is just about to come into force, will ensure that a search is made on every application for a patent, and that the inventor is informed what specifications within the last 50 years appear to anticipate his invention, but the applicant will be allowed to obtain his patent, even though it is clear that the invention is not new. Thus, notwithstanding the employment of the expensive machinery necessary to make a search, and for which the public pays, the black-mailing patentee will still be allowed to prey upon the small manufacturer and the public. The Patent Laws of Germany and the United States which Mr. Parsons commends, are free from this anomaly, but in this country the exaggerated notion that exists of the rights of the individual, permits the fraudulent individual to prey upon the inarticulate and long-suffering public. When this injustice to the public, who grant patents to encourage genuine invention, has been remedied by the forcible extinction of the privateer patent, it will be time to think of amending the Patent Law to provide due protection for the inventions required to carry out Mr. Parsons's 12-mile bore hole.

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Radio-activity at the British Association.

Prof. J. J. Thomson, in his paper on the radio-activity of ordinary matter, expounded the latest advance in our knowledge of this new property of matter. As the result of two years' work of Prof. Thomson and his colleagues in the Cavendish Laboratory, the conclusion has been arrived at, that many substances, such as lead, iron, tin, platinum and zinc, are radio-active, though to an immensely less degree than radium and the other well-known radio-active materials. Certain experiments made by MacLennan a considerable time ago pointed to the conclusion that many of the ordinary metals are radio-active to a slight extent, but radium was subsequently found to be so widely distributed as an impurity in all substances, that it was thought the radio-activity observed was due to the presence of slight traces of radium. Prof. Thomson has now shown that the radium impurity theory is not sufficient to explain the phenomena. The surfaces of the metals tested were made chemically clean, so as to remove radium deposited from the atmosphere. Curves were then drawn to show the rate of decay of the radiation. It was found that each metal had its own characteristic curve, and that all these curves were different from the curve of radium. The conclusion arrived at in the Cavendish Laboratory may apparently be safely accepted, though some of the speakers in the discussion, notably Herr Geitel, still clung to the old explanation of the effect being due to radium impurity. No proof has been obtained of the presence of emanations from these metals, though Prof. Thomson is inclined to think that emanations are present.

Mr. Fenton, F.R.S., described some experiments to show that, in some cases, radium had the same effect as sunlight in assisting oxidation by atmospheric air. A solution of tartaric acid containing a small quantity of ferrous tartrate was divided into two parts, and kept in the dark, in presence of air, one of the tubes being placed directly over a specimen of radium. On testing the solutions after a day or two with phenyl hydrazine acetate, a very striking difference was observed in the results, the exposed solution giving a comparatively copious precipitate of Nastvogel's osazone. As the effect of radium upon air is to break up the molecules into atomic ions, it would appear from this experiment that free ions have a much stronger chemical action than combined ions, a result which was to be expected.

Mr. Ackroyd discussed the colour phenomena presented by radium compounds. Radium salts when first prepared are white, but they gradually, thereafter, change colour, becoming in a month or two tawny yellow or orange. Mr. Ackroyd considers that this colour change is due to the reception of external radiant energy. The behaviour of coloured radium compounds when heated, is anomalous; instead of becoming darker in colour, they revert to their original white colour. It would appear from Mr. Ackroyd's paper that he is not yet, like Lord Kelvin, a convert to the atomic disintegration theory; he evidently still adheres to the view that the energy of radio-activity is derived from the absorption of external energy by the radio-active substance.

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Sound Municipal Policy.

The remarks made by Sir Francis Cory-Wright at the opening of the first section of the tramways owned by the Middlesex C.C. and leased to the Metropolitan Electric Tramways Co., might with advantage be taken to heart by other municipal authorities. Sir Francis pointed out that so long as the tramways were worked by a company, the large body of employés were no different from the general inhabitants of the district; whereas, if public servants, they would be in a position to combine, and thus, by their voting power, exercise a very detrimental influence on local politics. The same inefficiency which characterises certain municipally-worked tramways would extend to those of Middlesex. As arranged, however, no local stump orator can get into power or retain power by appealing to the self-interests of a compact body of voters.

Swollen pay-rolls do not, as a rule, characterise companies who must work at a profit. The contrary is known to be the case in many publicly-worked enterprises. Where, however, the local authority leases its lines and retains control over the working of them such abuses cannot creep in. At the same time the interests of the public are protected, and cars must be kept clean.

The arrangements between the lessors and lessees in the present case seem to be calculated to produce smoothness of working. The track is constructed by the authorities, who receive 4½ per cent. on its cost by way of rent. The equipment is provided by the lessees, who also receive 4½ per cent. upon the cost out of the gross receipts. Working expenses

are paid, and of the remainder the Council gets 45 and the company 55 per cent. Thus, while the Council retains control, it avoids the financial risk which no representatives of ratepayers have a right to incur. Its control is tempered by the fact that it participates in the profits, while being also the intermediary of the public complaints. The interests of the general public, the company, and the ratepayers as distinct from the general public using the cars, are thus equitably balanced, and it does certainly appear that in the arrangement arrived at, a happy solution of the tramways difficulty has been reached, and the ratepayers have been saved the loss which is almost inevitable where a tramway is run to secure the support of a body of voters whose interests are too often opposed to the general interests; and, what is better, the corruption of municipal affairs is avoided.

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Calorimetry of Hot Gases.

THE want of exact knowledge of the specific heat of hot gases makes it impossible to measure the heat sent away in the exhaust of a gas engine, even where both the temperature and the volume of the gases are known. It is easy to obtain the temperatures of these gases, but it is by no means easy accurately to determine the weight of air admitted to the engine, and so the estimate of the rejected heat is very rough, and, worse, it is very uncertain. Engineers will, therefore, welcome the paper of Prof. B. Hopkinson, presented at the Cambridge meeting of the British Association, which describes a calorimeter that has for its object the reduction of the waste gases to near the initial atmospheric temperature. Given an engine run at a steady load, the application of the apparatus for a definite time will measure the rejected heat, and this can at once be compared with the potential heat units supplied by the gas, and with the heat rejected at the jackets. The heat equivalent in the work done is known from the indicator diagram, and the missing quantity must be either imperfect combustion or radiation loss.

The apparatus consists of a section of cast-iron pipe with internal baffle plates, water sprays, and a final bubbling of the gases through water. It is found to reduce the gases to 120° F., so that there still remains some chance of error.

In different tests the balance unaccounted for was from 7 per cent. to 16 per cent., made up of this uncertainty plus radiation and conduction losses, and any errors in the measurement of the I.H.P. or of the jacket loss.

The heat measurement is of course obtained by the rise in temperature of a known weight of water flowing through the calorimeter. Where the rejected gases are so hot as 120° F., we should be sceptical of the results when a spray of water is mixed with the gas, owing to possible disturbing effect of steam. No doubt, however, the principle of thus measuring the exhaust heat is sound, and, if required for scientific research, might be carried into practice by a counter current surface condenser, so avoiding the disturbing effect of mixed water and getting more nearly down to atmospheric temperature. In the engines experimented upon there was nothing special, and the particular figures of the test are of no special interest.

The particular object before the author of the paper appears to have been to measure the heat supplied to an engine by measuring the work and wastes owing to the varying quality of the gas supplied to large engines from the gas producer.

The author finds for his particular engines that the unaccounted for heat in an engine better protected is less than 10 per cent. of the total heat, and he anticipates it may be worth while testing larger engines, and advises high pressure water sprays into the exhaust gases close to the engine.

## FLAME TEMPERATURES IN INTERNAL COMBUSTION ENGINES.

MR. DUGALD CLERK'S paper on "Flame Temperatures in Internal Combustion Engines," read at the Cambridge meeting of the British Association, is one that must attract attention. Like many other matters connected with this type of heat motor, the things which are thermodynamically possible are not practicable. All heat engines attain their maximum economy with a maximum of initial temperature of the working fluid, but there is no material that will work at the possible temperatures, and so these motors are found to be provided with a cold water jacket which renders it possible to work with high temperature gas. But the jacket does not merely protect the metal of the cylinder; it also absorbs much heat, and were it possible to obtain initially lower temperatures, less heat would be absorbed and the resulting efficiency might be improved.

The author points out that if the atmosphere had a pressure of double what it has, the pressure of explosion of a gas would be doubled for a given temperature, and non-compression engines would be more successful. Indeed, the compression combustion motor is simply a necessity which follows on an atmosphere of small density. Mr. Petavel has shown that the pressure of explosion of a mixture at 70 atmospheres — presumably cooled to ordinary temperature — was of the order of four to five tons per square inch. He found that heat loss from hot wires to a dense atmosphere increases very slowly with increase of density, whence it is inferred that the heat lost to the jacket does not increase more than a fraction of the ratio of pressure increase, an augmentation of one hundred fold of pressure, only adding six fold the heat to the walls.

This leads the author to consider the possibilities of artificially enhanced atmospheric pressure, because of the great flame temperature reduction that this would render possible.

The idea promulgated is to induce temperature by a sufficient dilution, and to enhance the mean pressure by high initial pressure from which to compress.

Calculated temperatures for coal gas are shown to range from 1,500° C. to 1,900° C. Certain producer gas diagrams calculate at 1,300° to 1,650° C.

Blast furnace gas diagrams show 1,400° C. The author considered it possible to get down to 1,200° C. by an artificially intensified atmosphere, and arranged an engine so that the piston overran a set of ports which communicated with an annular space carefully water jacketed. Compressed air was fed into the already compressed charge. The added air was compressed by a special pump, cooled, and admitted to the working charge in a second series of experiments, before compression. By this means the initial pressure of compression was raised from 130 lbs. to 190 lbs., the maximum from 460 lbs. to 565 lbs., and the mean from 89 lbs. to 110 lbs., with the result of increasing the thermal efficiency from 27·7 per cent. to 34·4 per cent. The temperature fell from 1,700° C. to 1,200° C.

In other experiments the additional initial pressure was secured by the agency of the exhaust gases, which passed by way of a cooled pipe to a reservoir, whence cooled exhaust products were admitted to the cylinder, and gave the enhanced atmosphere. This last method avoids the use of a special compressing pump. It must be observed that the added air or gas is added cold, so that compression in the cylinder starts from a low temperature, the fundamental idea being to increase the mean pressure without increasing the temperatures, thus avoiding over-heating and pre-ignition. Diagrams are shown in which the pressure of the charge is raised to about 7 lbs. above atmosphere in a four-cycle motor, of which the front end of the cylinder acts as an air pump, and also furnishes a scavenging charge. In this engine a high mean pressure of 100 lbs. is secured with a calculated temperature of 1,200° C. only. No water-cooled piston is needed, though the size is 21 in. × 34 in. stroke, and no pre-ignition troubles have been experienced. The author distrusts water-cooled pistons, though he admits they have been most ably constructed.

In his opinion many of the troubles of gas engines arise from the difficulties introduced in getting rid of the large

heat flow due to high temperature, and this he would avoid by the means described while maintaining and increasing mean pressures.

With blast furnace gas the question of maximum economy of gas is not yet of pressing importance. He would aim at low cost of upkeep and would reduce economy somewhat if by so doing breakdown could be avoided. The admission of cooled exhaust gases appears to him to be the best simple means of attaining the ends he has in view, and the method has even secured better efficiency. Exhaust super-compression has shown 32½ per cent. thermal efficiency where air has shown 34·4 per cent., but the exhaust is simpler to apply.

The author acknowledges the debt due to Thwaite, Atkinson and others, in helping on the large gas engine to success.

The reduction of flame temperature is all in line with the effect of late ignition as practised by Mr. Thwaite with blast furnace gas, and urged in these columns as an aid to economy because of the better conversion of heat as generated into work. It is in line also with the Diesel system which aims to apply heat to the compressed charge as required instead of all initially. Mr. Clerk himself, years ago, devised his Clerk cycle engine, which, with certain modifications, has become the engine of to-day and can be arranged to give super-compression.

It is astonishing to be told that 200 gas engines or oil engines, exclusive of petrol motors, are made weekly in Britain, and though the smaller class of engines may perhaps have attained very closely their maximum practical development, there is still room for improvement in the larger sizes, which offer so much more difficulty in respect of heat troubles, and hence it is that the question of flame temperature appears to the author the most important at present before engineers engaged on internal combustion engines. It is particularly important for all such as are endeavouring to employ the more powerful of the producer class of gases, such as contain the larger percentages of hydrogen, and are, therefore, more liable to premature ignition, a fault, perhaps, of small moment in small engines, but certainly serious in large and heavy engines. The comparative safety of blast furnace gas in this connection makes it the more regrettable that so litt'e attention has been paid by ironmasters to the extremely valuable pioneer work of Mr. Thwaite, who has so long urged the importance of this waste product and its comparative safety for high compression.

It has long been the aim of gas engine experts to produce a compound gas engine, the compound principle to be applied in the using of the explosive charge. To some extent this has been now carried out by Mr. Clerk in the utilisation of the exhaust to raise the initial mass of the charge to be compressed, but it begins to appear that the compound working of the internal combustion engine should be carried out upon the preparation of the charge rather than in its use, and that stage compression and inter-cooling promise to effect more than any stage expansion can be expected to perform. Any type of engine could be arranged with stage compression with a view to reduction of flame temperature and an increased mean pressure, whether of the ordinary or of the Diesel type.

The particular aim should be to convert heat into work as soon as generated. Theoretically, perhaps, a prompt and full explosion is correct, but this raises the head of temperature and promotes heat transfer through the walls: it produces needless shock upon all working parts, and it reduces mean pressure. Delayed ignition serves the same end as the prolonged fuel admission in the Diesel engine, and it also reduces the frictional loss of the main and cross-head bearings, and substantially supports the author's arguments in favour of reduced flame temperature. Mr. Clerk's paper marks another step in the progress of the internal combustion engine.

W.H.B.

## ELECTRIC RAILWAYS IN EUROPE.

The electric railway experiments on the Berlin suburban line between Niederschoneweide and Spindlersfeld, which have been in progress for a long time past, eventually induced the Prussian State Railway authorities to make a trial for a period of one year, of the system in operation, with a view to determining its applicability to railway working, and possibly in regard to the metropolitan railway in Berlin. As a consequence, the equipment supplied by the Union Co., which initiated the tests, was transferred to the State Railway authorities on July 4th. The railway is an experimental demonstration of the single-phase alternating current system, and its length slightly exceeds 2½ miles. The rolling stock comprises two motor cars and three trailers, and a train is composed either of a single motor car or of any combination formed of the five cars, in accordance with the requirements of the traffic. Each motor car is capable of accommodating 49 passengers, and each trailer 50 persons, so that the full complement of the five cars representing the entire rolling stock is 248 persons. These cars are quite adequate for dealing with the passenger traffic on this short line with its daily service of 24 trains in either direction. The single-phase motors with which each motor car is equipped are supplied with current from an overhead wire by means of small bow-shaped sliding collectors, and the return is formed by the track rails. The current is furnished to the motors at a pressure of 6,000 volts, and is obtained from the Ober-Spree power station. A slight fault developed in one of the motor cars early in August, but this was remedied by the next day, and the service has been maintained continuously since that time.

It is reported that progress is being made with the preliminary works and surveys which have been undertaken with a view to the introduction of electric traction on the Berlin metropolitan and circle railways. The experiments which have been made with electric trains in the German capital, notably on the Berlin-Lichterfeld line, have proved to be encouraging both from a technical and financial standpoint. The third-rail continuous current system is employed on the particular line in question. In some quarters the opinion is entertained that the single-phase method, as tested on the Niederschoneweide-Spindlersfeld railway, will be selected for use on the Berlin railways. The latter, and the suburban lines, comprise a total length of 362 miles contained within a radius of 18 miles from the centre of the city.

The question of establishing municipal electric railways of the underground type continues to engage attention in Berlin. A general plan of a proposed network of such lines has been prepared, and been approved by the Traffic Deputation, which is a committee of the Town Council. The deputation has also sanctioned a scheme for a north to south railway, which was originally suggested by the Underground Railway Construction Co. As recently modified, the project proposes the construction of a railway five miles in length at an expenditure of £2,450,000. In addition to this, the Siemens & Halske Co. is engaged on the preparation of a scheme and estimate of cost for the construction of a high level and underground line in the western suburbs.

It is understood that the Swiss Federal Council has under consideration the question of introducing electric traction on the State railways. A conference on the subject has already taken place between Government officials and representatives of the principal electrical engineering works, but the result of the deliberations has not yet been disclosed. In the meantime, it is stated that all difficulties have now been overcome which prevented the reconstruction of the State line between Seebach and Wettingen for electric traction. The work will soon be commenced with a view to its completion at an early date. It is reported from Brussels that a syndicate has been formed with a capital of £800,000 for the purpose of financing the building of electric railways in Switzerland and Italy. Any practical action has, however, been postponed, owing to the war, and the incidental difficulties of raising capital.

The Adriatic Railway Administration has now definitely taken over the entire equipment of the so-called Valtellina railway, which connects together Lecco, Colico, Sondrio, and Chiavenna. The working of the railway, which was constructed by Messrs. Ganz & Co., of Buda-Pesth, has been undertaken by the Administration itself as from July 10th. Since the transfer of this high pressure alternating current line, a Milan correspondent of a German newspaper states that the operation of the railway, and of the Milan-

Callarate-Varese-Porto Ceresia electric railway, is regarded in trade circles as being so costly, that it is doubtful whether the financial results will be satisfactory. This statement can, however, scarcely be correct in view of the comparatively long period during which the Valtellina line has been at work, and the fact that the Administration has now assumed the management of the railway from the contractors. The Milan-Porto Ceresio Railway is worked on the third-rail system with direct currents, in conjunction with generators and rotary converters, on the Thomson-Houston method. It is proposed to extend the line to Lugano, this showing, also, that the charge of unfavourable financial results, which is unsupported by figures as to the actual revenue and expenditure, cannot be maintained.

## THE ZOELLY STEAM TURBINE.

By WALTER RAPPAPORT.

Before the invention of the steam turbine, the Pelton water wheel was the machine that attained the highest number of revolutions per unit of time. It is, therefore, not surprising, that several steam turbine types look very similar to the Pelton wheel, especially two of these, *i.e.*, the Zoelly and the Riedler-Stumpf turbines.

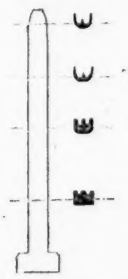


Fig. 1.—Elevation and Sections through Turbine Blade.

The Zoelly turbine, as constructed by the large engineering firm of Messrs. Escher, Wyss & Co., of Zurich, consisted, according to the original patents, of a single moving disk with radial vanes, the section of which was extraordinarily similar to the buckets of a Pelton wheel. Such a vane is shown in fig. 1.

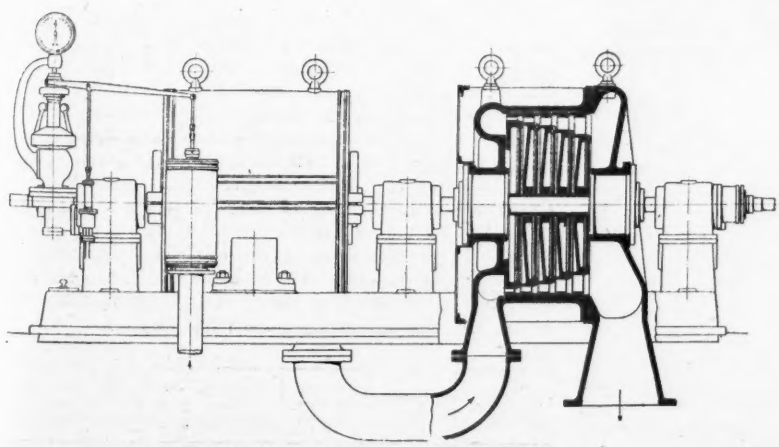


Fig. 3.—Modern Compound Zoelly Turbine.

The moving wheel itself consists of two steel plates, between which the buckets are inserted. The plates are held together by a few screws. A certain number of nozzles, according to the capacity of the turbine, were placed at the circumference of the wheel; there the steam expanded, and was guided tangentially over to the vanes of the moving wheel. The first turbine, built according to this principle, had only one pressure stage; later on it had several, no velocity staging being applied. The high pressure part consisted of a number of wheels as above described, each revolving in a closed chamber, the low pressure part having axial injection. Such a turbine is shown in fig. 2.

The Zoelly turbine of this type has not proved satisfactory, the steam impinging upon the vanes being divided into two parts. The route of the steam was thus very complicated, and the steam economy not a very high one.

In its modern construction, the Zoelly steam turbine is similar to the Rateau type, but is more carefully worked out in its details. The wheels do not now consist of steel plates screwed together, and the vanes are not singly riveted on, the internal friction being greatly reduced in modern construction.

The modern Zoelly turbine is a purely action-turbine, with about 10 pressure stages. Like the Parsons turbines, especially with large units, the Zoelly is divided into two parts, a high and a low pressure turbine, the shafts of these being connected by a coupling. Such a compound turbine is shown in fig. 3. On the left is the high pressure cylinder, in front the admission valve with the governor, at the right hand the low pressure turbine with the exhaust pipe, and between them the receiver. The steam enters the first guide wheel through the admission valve, as described later on. As in the Rateau turbine, the injection is in the beginning only a partial one; otherwise, the steam energy could not be thoroughly utilised in the later stages. The steam expands in the guide wheel to a certain degree, gives up the velocity thereby gained to the first moving wheel, and it then expands in the second guide wheel, and so forth.

The moving disk, as shown in figs. 4 and 5, is made

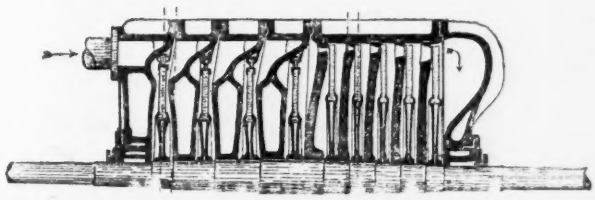


Fig. 2.—Early Type of Zoelly Turbine.

of Siemens-Martin steel, highly polished, so that the internal friction is very small. The moving blades are nickel steel, and are thus not liable to corrosion. A ⊥-shaped slot is machined out of the circumference of the disk, into which the blades are inserted, the slot being closed by a ring, *s*, riveted on after all blades are in their places.

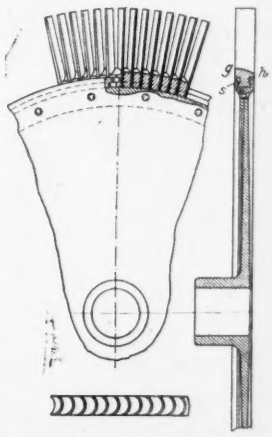



Fig. 4.—Turbine Disk Wheel.

Between the single blades, distance pieces are put in, the outer end of these being shaped to the curve, *g*, *h*, according to the steam expansion. As by this radial enlargement of the blade passages a bigger section is offered to the steam at the point of exit, Zoelly was enabled to take a larger angle at the point of exit than at the entrance, contrary to Laval, who made them both of equal size. The blades are made on a specially constructed milling

machine. Finally, the complete moving wheel is carefully balanced.

The diaphragms between the several moving wheels have to be sufficiently strong to resist the difference of the steam pressure in the preceding and subsequent chambers, and are consequently made of cast-steel. As the casing is horizontally divided to permit an easy approach to the moving disks, so, also, have the steamtight, diaphragms, inserted into the casing, to be horizontally divided. This, of course, is a very great disadvantage, as it is very difficult to face the two halves absolutely true, and as it is further impossible to notice while working where a leakage of steam takes place.

The guide blades are formed of steel plates, as shown in fig. 6, and, with the projections, $n$, are inserted into the slots, $l$, of the diaphragms, fig. 7, wherein they are fixed by the annular rings $o_1$ and $o_2$. The play between the boss of the wheels and the diaphragms is very little, and is made steamproof by special arrangements in a similar manner to the Parsons turbines.

The characteristic part of the Zoelly turbine is the governing mechanism, fig. 8. The centrifugal governor, which by worm gearing, is directly driven from the turbine shaft, acts, at first, upon the piston $m$ only. Oil is forced under pressure by a small centrifugal pump through pipe $a$ to the small cylinder in which $m$ moves, and thence, when the

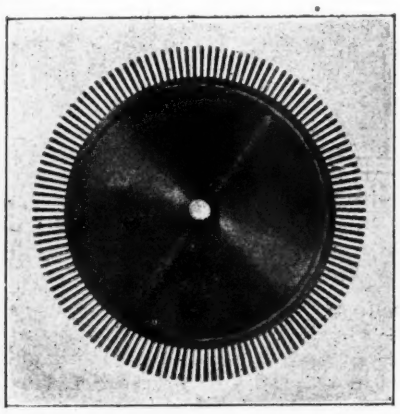
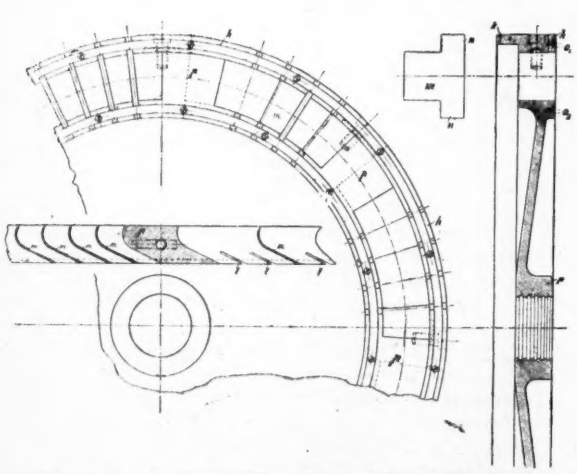


Fig. 5.—Complete Disk Wheel.

piston, $m$, allows it, through pipe $f$ to the upper side of the piston $h$, which is directly connected with the admission valve, $k$. As soon as $h$ is pressed down, so, also, $k$ moves downwards, and the steam pressure at the entrance into the



Figs. 6 and 7.—Fixed Diaphragm and Guide Blades.

turbine drops. Through pipe $c$ the oil, which was underneath the piston $h$, returns to pipe $b$, and thence into the suction tank of the centrifugal pump.

The admission valve is closed completely in cases of excessive speed, and does not allow any steam to enter the turbine.

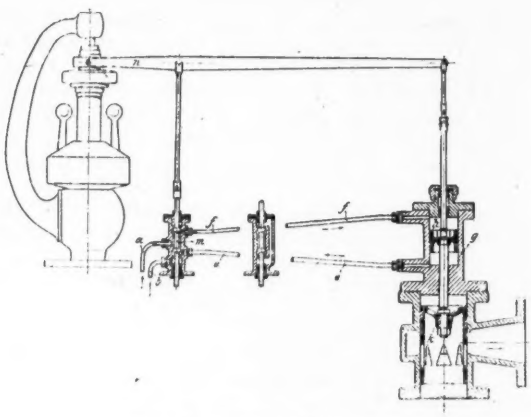


Fig. 8.—Governor Mechanism.

In case the governor should not act, there is also provided a small safety governor, which immediately closes the admission valve by means of a spring. This kind of governing has often been successfully used by Messrs. Escher, Wyss and Co., for their water turbines.

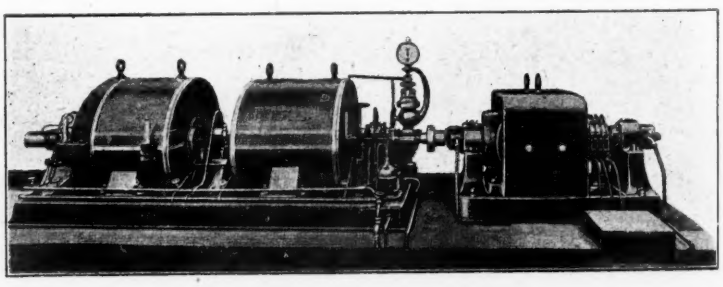


Fig. 9.—Zoelly Turbo-generator Set.

Besides this, by special piping arrangement, one is also enabled to admit live steam to the low pressure part of the turbine, and thus to overload it. A view of the turbine is shown in fig. 9.

More information is available about the steam economy of the Zoelly turbine than of any other turbine. Prof. Stodola, conjointly with the director of the electric light works of Zurich, Mr. Wagner, made exact tests on the steam consumption of this turbine. The experiments were made on a 10-stage turbine of a capacity of 500 H.P., 3,000 r.p.m., and a steam pressure of 142 lbs. per sq. in., directly coupled with a Siemens & Halske three-phase generator. The condenser was driven independently, its power consumption being 1 to 1·5 per cent. of the actual capacity of the turbine, which was not considered in the table of steam consumption. The dynamo was excited by an independent source, and this consumption of power deducted from the actual capacity. The trial gave the following results :—

| No. of revolutions per minute. | Capacity. KW. | Steam pressure. kg/cm². | Temperature Centigrade. | Condenser pressure. kg/cm². | Steam consumption. kg/KW.-hour. |
|---|---|---|---|---|---|
| 2,967 | 363·06 | 10 1 | 179·9 | — | 9 874 |
| 2,967 | 387·65 | 10·11 | 180 | 0·046 | 9·742 |
| 2,977 | 334·51 | 9·03 | 175·1 | 0·047 | 10·07 |
| 2,983 | 240 1 | 6 92 | 164·9 | 0 05 | 10·916 |
| 2,984 | 182·22 | 5·47 | 156 6 | 0·053 | 11·657 |
| 2,995 | 80 13 | 3·07 | 136 | 0·044 | 15 |
| 2,995 | — | 1·22 | 108·8 | 0·044 | — |
| 3,000 | — | 0·742 | 102·9 | 0·046 | — |
| 2,972 | 391·66 | 9·72 | 216 5 | 0 04 | 8·633 |
| 2,973 | 389 6 | 9·72 | 219 | 0 042 | 8·539 |
| 2,968 | 390·4 | 9·8 | 216·5 | 0·042 | 8·98 |

## OUR IRON AND STEEL TRADE.

[COMMUNICATED.]

(*Concluded from page* 360.)

In any particulars where the tariff report seems to have the argument on its side, it will be found that special periods are chosen. When did the war begin? Then why does the period since the war began coincide with lack of employment? Much of the available capital of the country has gone into unremunerative municipal loans, and, in addition, we have spent £250,000,000, more or less, on a war which might have been avoided by early firmness. We have put up our national expenditure beyond the mere war increase, and we are asked to attribute the results of this waste of our wealth entirely to other causes.

One of the firms supplying information to the Commission says:—

"It is not all foreign competition one has to fear. Our house at home requires setting in order. Railway rates, high local rates, excessive taxes brought about by reckless and extravagant spending of money, all have to be reckoned with in getting at the cost per ton."

Firm No. 619 is not conscious of any loss of trade by foreign competition, or any inroads on markets supplied by them. It would be, therefore, somewhat instructive to know what manner of firm this is, and how it is managed and organised.

Another firm points out that engineers who most rigidly specify hard conditions for English goods accept stuff from foreigners that does not come near the specification. This is, we believe, a common complaint.

What can be done where our engineers are cognisant of this practice and allow it to continue?

Important as the subject is, we will pass the question of royalties merely by quoting the report before us, that whereas in Germany these do not exceed 6d. per ton of pig, and in France 8d., they amount to no less than 4s. 10d. in Great Britain. Is this pure greed on the part of the land-owner who exacts such an exorbitant sum?

The report is long, and in small print, and would take up much time to go through in its entirety, but the evidence of firms is quite sufficient to show that the causes we have named, the lack of standards, &c., would, if removed, be of vast help.

Even those who call for some duties would not tax all things, for to do so would send up prices unduly, and be a tax on the manufacture of more finished products.

All-round tariffs would be a species of industrial war, and we believe everyone looks on tariffs as a means of retaliating upon the foreigner for the way he treats us. But if retaliation is to be the order of the day; if war is to be levied, why not go about it in a thoroughly English way, and, while adhering to Free Trade generally, levy a special and distinct war against all the products of some one country. To levy tariffs generally is expensive. It would cost far less to take the whole of the imports from, say, Germany, in a mass, and put on a 100 per cent. duty here and in India, as an act of pure retaliation. This would harm Germany more than it would harm us, but it would do us harm, of course. Let there be no misunderstanding. A tariff war would cost money. If by such a war we speedily reduced our enemy to reason, the war might pay for itself in results. But if he, also, determined to fight to a finish, both countries would lose more than they could possibly gain.

But the Tariff Commission's advice amounts to tariff tinkering. It seems insufficient to effect a good purpose—too light to use as a lever and useless as a bludgeon. If there are doubts as to the value of free imports, an unbiased Commission would form a better tribunal. If a fight is to be made, let us select our enemies one at a time, and let us know that we are fighting because we are tired of foreign insolence. But why start the fight with the whole world? We would fight with anyone, and pay for it, but we cannot see any good in the half-measures of the Commission. Mere jealousy of the progress of other countries in the iron and steel trades will certainly not serve us. The deposits of Lake Superior ore and the ore deposits of Germany were bound to be utilised in course of time. We quite admit that dumping is productive of much hardship to individual firms, and recognise the force of the argument that if prolonged so as to destroy our own industries, prices of dumped goods would rise. But it has not been shown yet that such an amount of dumping has been practised as seriously to affect matters, whereas it is common knowledge that until recently large numbers of our own manufacturers have spent their revenues up to the hilt and allowed their works to deteriorate to a non-competitive level; that they have consistently refused to employ men at good salaries, possessed of better technical knowledge, and that they have had neither the courage nor the capacity to take hold of new things or the technical knowledge to discriminate between things good and things bad in principle.

These various backwardations combined with the waste of the war, and intensified by two bad wet years in succession, have been ample to account for the present condition of affairs. The influence of wet seasons in 1876-7-8-9 and 1880 showed itself in such a shrinkage of trade that everyone spoke of the country as being on its last legs. John Bright pointed out the value of sunshine, for lack of which the biggest industry of the country—agriculture—was suffering. He realised the great truth that everything came from the earth, and that sunshine, and that alone, with the aid of not too much water, was the mainspring of prosperity—nay, of our very existence. As regards our over-sea trade, we make a great fuss over the supply of a portion of the wants of the five million people of Australasia, and forget the forty millions at our own doors. So far as foreign trade is of value to us, it is paid for by our own products. We certainly pay no gold for it, for we produce very little of that metal, and if we did produce gold in large quantity, it would be better for us that we should pay in this metal than in wool, or coal, or cloth, or iron, for we should have so much more of these things for the many among us who do not get sufficient. Tariff fallacies are closely bound up with equally fallacious ideas about the value of gold, a value merely nominal and artificial because of the consensus of agreement to employ it as a medium of exchange. Now, how many tariff reformers would have any objection to raise if Germany began to dump on the quays of Millwall Docks one ounce of gold for a ton of coal?

According to the report before us, the German people are paying heavy prices for steel, in order that German steel makers may put down steel in England at less than cost. Americans are complaining that their tool-makers have to pay for cast-iron more than the English tool-makers, who buy American pig at a price less than it is sold for in America. Meantime, if we are to believe Mr. Carnegie, the cheap ores of America are growing scarce, and we, who have already begun to find the scarcity of coal and ores, will have less severe competition in future. Would our people only wake up and insist on the abolition of extortionate royalties, on the bringing into line of the foreigner, where we can properly compel him to mend his ways, on organising the great agricultural interest on a proper basis, there would be little need to fear the receipt of a ton and a half of foreign steel in exchange for the equivalent of only a ton of it in such medium as we have to pay with.

Indeed, this tariff report shows the way we ought to go to alter things, but it is not the way of the tariff reformers.

To quote one reason only why our manufacturers cannot compete in Australia, the report says he "cannot compete when," because of freight excess, "he must start £1 per ton under the foreigners' prices." "Antwerp stuff is sent over" to the Thames "by the General Steam Navigation Co., and lightered along the same ship." The Antwerp stuff pays 28s. to Australia, "*viâ* the Thames," and the British stuff 45s. Verily our enemies are indeed those of our own household.

To South Africa the freights on Classes I. to IV. are from a third more to three times more than from New York. That competition is not all dumping was shown in these columns on February 22nd, 1901, to the effect that Germans were getting £5 to £6 per ton for tramrails while our own rail mills were rolling ordinary rails for 70s. to 75s. Now, either it paid our works to occupy themselves on plain rails at the lower price, or they had not go enough to take orders at the higher price. Our own manufacturers have often let opportunities slip for lack of judgement in diagnosing the permanence of a demand.

Complaints have been made that our skilled work has been diminished by the foreign imports, yet the chief complaint as to dumping is of billets of steel which are worked up to higher grades, or of forgings which are worked into ships.

As regards the limited tariffs proposed by the Commission, it is certain that, from some of the prices quoted, they would not stop dumping if a German firm wanted money as badly as some of them have needed it during the past three or four years. Trade has been bad with us; it has been worse in Germany. The unemployed in the United States are probably in greater proportion than here, for we read of one company—the Baldwin Locomotive Co.—discharging 10,000 of its 16,000 men. When all the world suffers it is natural that some of the suffering should come this way. No evidence is adduced that anything has taken place that would warrant a change in fiscal policy, while much can be read directly and between the lines, to show how much might be done to reform things from within. If we take the case of the machine tool trade as an instance of what can be done by self-reform, we see a trade that had fallen to a low ebb in this country. American tools come here in large numbers, and it really appeared, at one time, as though they would capture the market. Germany, also, began to send tools here. But our own makers woke up, and did so pretty smartly. They have fairly ousted the Americans, whose tools were inclined to be light, or, where heavy, were dearer than our own. Germany, with her inferior copies of American tools, never was able to compete after our own makers woke up. The English machine tool-makers hold the field, and have, moreover, gone far ahead in the use of the new tool steels and in supplying machines strong enough to use them.

As other branches of industry similarly bestir themselves, so shall we see a similar ousting of the foreign article, for dumping does not go on for ever, and no amount of sophistry can get over the hard fact that goods sold for less than cost cannot benefit the country of their origin. No doubt dumping of materials made from paid-for raw materials is an extremely convenient proceeding under certain circumstances. When a man is hard up in summer time, he may find it convenient to place his winter overcoat in his avuncular depository, but he has to pay for it in the long run, or go cold. Dumping is but a form of pawning goods for ready cash. The foreign manufacturer pawns the goods and gets the money, but the foreign public pay for the cost—they meet the loss.

Finally, the monthly returns published on August 12th cannot but contradict the claims of the fiscal reformers. They show that the over-sea trade of our small islands is greater than that of the United States, despite the enormous discrepancy of relative areas, and a population of little more than half. In addition, working hours are shorter here.

## THE PRIVATE SUPPLY OF ELECTRICITY.

[From our Legal Contributor.]

Although we have frequently dealt with the question whether electricity can be supplied otherwise than under the powers conferred by provisional order, we continue to receive queries from our readers upon the subject. In these circumstances a short review of the law may be found useful. The fact that electricity is usually supplied for purposes of light and power under a provisional order or special Act appears to give rise to the belief that it is illegal for a private person to generate current and supply his neighbour on terms which may be arranged between them. This is a fallacious view of the law. The Public Electric Lighting Acts, which control and regulate the supply of electricity, are enabling only—that is to say, they confer certain rights and powers upon the holders of a provisional order; but they do not prohibit, and only control in a very limited degree, the private supply of electricity.

The Electric Lighting Act, 1882, made no provision whatever for regulating the supply of electricity otherwise than under a provisional order or a special Act. Thus, after that Act was passed, whereas persons who supplied electricity under a provisional order were subject to elaborate rules made by the Board of Trade in carrying out the details of their undertaking, the owners of an installation who furnished their neighbours with a private supply were under no restriction whatever. For instance, by regulations made under the Act of 1882, the use of aerial lines was very much restricted; but these rules only applied to statutory undertakers.

It was in order to bring private supply companies under the jurisdiction of the Board of Trade that a special clause was inserted in the Act of 1888. By Sec. 4 of that Act, it was provided that where in any case any electric line or other work may have been laid down or erected in, over, along, across, or under any street, for the purpose of supplying electricity, or may have been laid down or erected in any other position for such purpose, in such a manner as not to be entirely enclosed within any building or buildings, or where any electric line or work so laid down or erected may be used for such purpose otherwise than under and subject to the provisions of a licence or provisional order, the Board of Trade may, by notice served upon the body owning or using the line, require that such line shall be continued and used only in accordance with conditions and rules which they may prescribe.

A proviso excepts from the operation of the section "every electric line or work laid down or erected by any body or person for the supply of electricity generated upon any premises occupied by such body or person to any other part of such premises." Any person failing to observe the regulations and orders of the Board of Trade is subject to penalties.

To avoid the necessity of drawing up sets of rules for every case, the Board of Trade have issued regulations drafted to meet the requirements of this section, the general effect of which is very similar to those which have to be observed by companies and local authorities which supply electricity under statutory powers. To deal with them at length would be beyond the scope of the present article. It may be pointed out, however, that Regulation 2 prohibits earth connection, except in the manner there provided. Regulation 4 limits the pressure between any two conductors or between any part of either conductor and the earth, to 3,000 volts. Regulation 14 substitutes 100,000 watts for the 300,000 in the ordinary regulations, as the limit which a high-pressure electric line may be used for transmitting. Regulation 17 provides precautions against injurious affection by induction; while Regulation 18 contains special provisions for the protection of the Postmaster-General.

Compliance with the Board of Trade regulations does not always completely protect a man who supplies electricity in the manner above described. He may have to observe certain by-laws issued by the local authority of the district in which his works are situated.

Thus he may find it necessary to lay his mains across a highway, and in seeking to do this he may come into conflict with the local authority who have control of the highway. This is nearly sure to be the case if the local authority are themselves supplying electricity in their district under provisional order, as they will naturally desire to restrain competition by every means in their power.

Dealing first with the question of overhead wires, it is clear law that unless the local authority own the soil of the highway, they cannot entirely prevent the suspension of overhead wires if placed at such a height that they are completely out of the way of the traffic. This point was made quite clear some years ago in a case which was decided in the High Court. Those who wish to lay cables across the highway have only to make an arrangement with the landowners on either side by which they can obtain leave to erect posts for the suspension of the cables. In the rare case, however, of the local authority owning the soil of the road, it will be within their power to absolutely prevent any cables being so suspended, as the presence of such cables constitutes a technical trespass, the continuance of which may be restrained by injunction.

It should also be observed that in urban districts the local authority, by adopting Part II. of the Public Health Acts Amendment Act, 1890 (53 and 54 Vict., c. 59), may acquire power to make bye-laws

for the prevention of danger or obstruction to the public from posts, wires, tubes, or any other apparatus stretched or placed above, over, along, or across any street (whether before or after the adoption of that part of the Act) for the purpose of any telegraph, telephone, lighting, railway signalling, or other purpose. Again, in the case of London, overhead wires can only be erected in accordance with bye-laws made under the London Overhead Wires Act, 1891.

Coming now to the question of laying mains beneath the surface of the road, it may be stated, broadly, that no private person has any right to break up the surface of the road without the consent of the highway authority. Further, there is a section of the Public Health Act, 1875, which prohibits any man from placing a tunnel of any kind under a highway without consent. It would be competent for the highway authority to obtain an injunction to restrain the continuance of such a tunnel, and so to compel the person who made it to fill it up.

Strange to say, however, if a man who is venturesome enough to take the law into his own hands, he may lay cables under the road without much fear of interruption, always assuming, of course, that the local authority do not own the soil. Two cases which have come before the Courts in recent years illustrate the truth of the above proposition. In the case of the Vestry of St. Mary, Battersea, *v.* County of London and Brush Provincial Electric Lighting Co. (1899, 1 Ch., 474), where an electric lighting company had illegally broken up the surface of a street within the district of a vestry in the metropolis, and placed their pipes and wires at a depth of about 2 ft. below the surface, it was held that the vestry were not, by virtue of Sec. 96 of the Public Health Act, the owners of the soil of the street at that depth, and that, although the company had acted illegally in breaking up the street, the vestry could not maintain an action for a mandatory injunction to compel the company to remove their pipes and wires, there being no continuing trespass upon, or interference with, any right of the vestry. With reference to this case, it made no difference that the trespassing company were statutory undertakers. A private person doing the same act would have been treated in the same way.

In the second case to which we wish to refer, a shipbuilding firm had works which were divided into two parts by a public highway. To supply electricity from one side to the other, they applied to the local authority for leave to suspend cables over the highway, or to drive a tunnel beneath it. The local authority having refused, the firm drove a tunnel, which constituted an infringement of the Public Health Acts. They laid their cables at the bottom of the tunnel. The local authority applied for, and obtained, a mandatory injunction to compel the firm to fill up the tunnel, but the Court refused to compel them to remove the cables. In this way they gained their object by taking the law into their own hands.

The question sometimes arises whether supply undertakers are obliged to give a supply of electricity in the case of consumers demanding it, when the object for which they intend to use such supply is to provide a standby source of lighting in case their own plant should break down. There is nothing in the existing Electric Lighting Acts to prevent a consumer adopting the course suggested. He may be required to give particulars showing the number of lamps or the amount of power which he requires, but there is nothing in their statutory powers to enable an electrical company to compel the consumer to take a continuous supply. It is interesting to note, however, that a Bill which has lately been before Parliament contains the following clause :— "Notwithstanding anything in the Electric Lighting Acts or in any Act of Parliament or Provisional Order authorising an undertaking, a person shall not be entitled to demand from undertakers authorised to supply electricity in any area a supply of electricity for any premises having a separate supply, unless he has agreed with the undertakers to pay to them such minimum annual sum as will give them a reasonable return on the capital expenditure, and will cover other standing charges incurred by them, in order to meet the possible maximum demand for those premises. The sum to be so paid shall be determined, in default of agreement, by arbitration under the Electric Lighting Act, 1882.

## CORRESPONDENCE.

*Letters received after first post on Wednesday morning cannot appear until the following week.*

### Unfair Competition.

Having read "B's" letter on the above subject, I beg to endorse his opinion, and, at the same time, add a few experiences of my own. For the last six months I myself have been writing in answer to situations vacant, sending testimonials, &c., but never in return receiving a reply. The most disheartening fact, however, is that, while you are striving to obtain a situation at a wage that will keep you respectable, there are people who are willing to pay for situations, and not only that, but willing to accept small wages in return for their work. How are we, I ask, who are dependent on our work for a living, even though we be smarter intellectually, going to compete with such ?

I also wish to add a few words on trying to obtain work by visiting the workshops. Arriving at the watch house, I inquire for the manager, and if I am fortunate to see him, the interview is generally brief, and partakes of the following nature : "Well, what do you want ?" "Can you find me a situation ?" "Oh ! what are you ?" "A mechanic." "No." "Full up." "Slack" ; or "Don't want any." For what he cares, you might as well have come from the next street as have ridden 30 or 40 miles to get to see him, and the mention of education is enough for him to throw you out. I hope that letters of this kind help other men to bear their own burden better because they get to know that other people are daily passing through the same experience.

**Educated Mechanic.**

### Steel-tired v. Chilled-iron Wheels.

We have followed with great interest your articles on the question of Steel *v.* Chilled-iron Wheels for electric traction, but as manufacturers' views are naturally in favour of their own goods, do not propose to enter into the discussion. From the fact that most of our largest tramways have discarded chilled-iron wheels, and that we have over 30,000 steel-tired wheels running, we are inclined to think that this type of wheel is making headway, at all events, we are perfectly satisfied with the progress. Time will prove which is the better wheel, and we are content to leave the matter there.

**John Baker & Co. (Rotherham), Ltd.**
H. E. Baker, *Secretary.*

*August 25th*, 1904.

### Electrical Rock Drills.

I find one pneumatic percussion rock drill requires from 20 to 25 H.P. Would not electricity do much better than this ?

I am informed that electric rock drills are in use in America, so have been examining your Review weekly in quest of some enterprising firm's advertisement.

**Quarry Owner.**

[On p. 249 of our issue of February 12th, 1904, a correspondent made some reference to this question, and his letter may be of service to "Quarry Owner."—Eds. E.R.]

### Localisation of Earths.

I regret that by a clerical error, line 26 of my last letter, as appearing in your issue of August 26th, should have been "The first test is taken with a galvanometer in position A," and not "The first test is taken with a galvanometer in position B" ; this is obvious from what follows.

**Horace Boot,**
*Consulting and Resident Engineer.*

Tunbridge Wells, *August 26th*, 1904.

I have to thank Mr. Boot for his diagram of test for a short on a concentric cable, and if the following conditions obtained, it could not fail to give good results.

(*a*) The resistance of the fault must be constant whilst the testing current is flowing.

(*b*) The resistance of the buried outer per yd., at the temperature of the soil, must be accurately known.

As to (*a*) it is hardly likely that the resistance of the fault would be constant unless the inner and outer were welded together, in which case a simple copper resistance test would give equally good results, and as to (*b*) a temperature correction which it would be very difficult to arrive at accurately would have to be made. Also it is very difficult to get at the exact resistance of an outer unless taken before the cable is laid or a fault has developed, and the maker's figures, especially of old cables, are not always accurate; in fact, I have handled cable in which there was over 50 per cent. difference in the sectional area of the inner and the outer, but no doubt that was an exceptional case due to carelessness in manufacture.

Anyway, I still think a loop test is infinitely preferable where it is possible to carry it out, as no temperature corrections are necessary, and there is no trouble with E.M.F. or resistance in the fault, and four separate tests can be taken to check each other by simply crossing the test leads.

However, I will give Mr. Boot's method a trial when I have an opportunity, and report results.

**Arch. J. Howard.**

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### Electric Tides and Earth Currents.

By inadvertence fig. 2 of my article—the sine curve—has been printed upside down. That involves also the reversal of left to right, and making the positive signs appear below the zero line and the negative signs above, which is out of harmony with the convention observed in the rest of the article.

**W. H. Sharp.**

Manor Park, *August 29th*, 1904.

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### The Telegraph Deficit.

It is quite true that all of the capital spent on the absorption of the telegraphs by the Post Office did not go to the extinguished telegraph companies. I should have stated the matter more accurately if I had said that "the total capital expenditure on the *transfer* of the telegraphs was £10,948,173." At the same time, I thought it was well-known that the railway companies were large owners of telegraph rights and properties, and that a substantial portion of the capital went to purchase those railway telegraph interests. It did not seem to me possible that the article of August 19th could have been written with a knowledge of the official returns, as it gave the impression that the original purchase has cost about £5,000,000, and that the Post Office had spent about another £5,000,000 up to 1891, when the capital account was closed. This is clearly not in accordance with the facts. However, my letter was intended to be brief rather than to be so curt as to give offence. I had no intention to give offence, and have no wish to bandy hard words; my only desire is to see the facts stated with reasonable clearness.

It is no easy matter to determine from the various published records exactly what was the distribution of the total capital expended on the transfer of the telegraphs from private to public ownership. One point is clear; that the total was much greater than was contemplated by the Act of 1869. That Act anticipated a total expenditure of less than £7,000,000, whereas by 1876 the capital expenditure had reached £10,070,826, and arbitrations still pending were expected to add £600,000 or £700,000 more. From a report by Mr. Scudamore, dated June 26th, 1871, the capital spent or incurred up to then was £7,518,955. Of this £5,950,996 had gone in payments to the telegraph companies, about £600,000 in extensions, and about £850,000 in payments to the railway companies and in miscellaneous items. There were still arbitrations pending both with telegraph and with railway companies, but the major part of the three millions added to the capital account between 1871 seems to have gone to the railways.

In the evidence of Sir Stevenson (then Mr.) Blackwood before the 1876 Committee, the capital account of the Post Office Telegraphs at March 31st, 1876, was estimated as follows:—

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|---|---|
| By amount paid for goodwill and plant of old telegraph companies, extensions by the Post Office, preliminary expenses, &c., up to March 31st, 1897 ... ... ... ... | £9,360,961 |
| By estimated value of telegraph rights of railway companies, and estimated value of annuities to redundant officers of late telegraph companies if commuted ... ... | 590,000 |
| By cost of extensions charged to telegraph vote ... ... ... ... ... ... | 82,594 |
| By cost of sites and buildings charged to telegraph vote ... ... ... ... ... | 37,271 |
| By sundry balances, including £64,876 unexpended out of capital raised to March 31st, 1876 ... ... ... ... ... ... | 249,226 |
| Total ... ... | £10,320,052 |

Government officers have a princely way of dealing with millions, and details of the respective amounts chargeable to purchases of the telegraph companies' properties, of the railway companies' interests, and to extensions by the Post Office itself, are not given. As the editors of the Review have pointed out, the "&c." is not unimportant. Presumably, a detailed record of the constitution of the telegraph capital account exists somewhere, but a search of the published returns does not reveal it. From what appears in the reports of the various investigations into the rapid growth both of the capital account and of the expenses which were conducted in the seventies, the present capital of £10,948,000 may roughly be distributed as follows:—

| | |
|---|---|
| Purchase of telegraph properties... ... ... | £6,000,000 |
| Purchase of railway companies' telegraph interests and rights... ... ... ... ... ... | 2,500,000 |
| Reconstruction and extensions by the Post Office up to 1873, including sites and buildings ... | 1,500,000 |
| Pensions, arbitration and preliminary expenses, and miscellaneous ... ... ... ... | 948,000 |
| | £10,948,000 |

It appears that since 1873 the expenditure on extensions and sites and buildings has been charged against revenue. The total amount so expended up to March 31st, 1904, has been £6,300,715.

Sir Stevenson Blackwood was asked in 1876 to what circumstances he attributed the great discrepancy between the £7,000,000 anticipated by the Act of 1869, and the amount actually spent. He replied:—"Mainly to the purchase of undertakings which were not contemplated at the time when the original measures were submitted to the House, and to unforeseen expenses for extensions and arbitrations; I am unable to give any other specific reasons. There is no doubt that considerable expenditure took place which never entered into the minds of the original promoters of the measure for the acquisition of the telegraphs; that is to say, that the Post Office has been compelled to buy a very different thing from that which it at first contemplated, and to pay a far higher rate than it expected for that which it intended to buy."

**Scrutator.**

*August 29th*, 1904.

[The figures which Sir William Preece gave are suggestive of some precision, and the circumstances under which they were given suggest some responsibility. Whilst they may be open to correction or explanation, we think that some more definite information is required before calling them in question. Our correspondent's figures support in greater detail the first point of our article; they have, of course, no bearing on the second point, which showed the unreliability of popular criticisms on the working of the service.—Eds. E.R.]

## REVIEWS.

*La Traction Electrique.* By Paul Dupuy. Paris: C. Naud, Editeur, 3, Rue Racine. 1903.

This is a book of some 500 pages, which would have enjoyed a large sale if it had been published in English between 1896 and 1900. It is obtainable only in the original, and we regret that there is so much between its covers which relates to obsolete machinery and appliances, for in its present highly expanded form one cannot urge any but those to whom French, and technical French at that, presents no difficulty, to go to the expense of buying it. Doubtless it is most desirable that every engineer shall at least read the language with facility, and it would seem to traction engineers that no more satisfactory mode of practising themselves in this accomplishment could be found than by translating a text-book of this nature; but to anyone with moderate experience and an acquaintance with English and American literature on the subject, the amount of knowledge to be gained is not great. There is a yawning gap in English technical literature to be filled by an up-to-date book on electric traction. How hard it must be to write and publish a book such as we want while the subject matter is still fresh and fitted for practical application is well seen after reading "La Traction Electrique." There is sufficient internal evidence to show that the book was begun in 1895 or 1896, and it would be very surprising if publication of such a vast amount of matter could be made before it was.

Electric traction has developed so speedily, and improvements have succeeded improvements at such a rate, that data relating to costs, illustrations of machinery, the very systems themselves, become of more interest to the historian of the science than to the man who is engaged in, or is in process of, launching himself into the actual business, almost while the work containing them, or describing them, is in the press. One is forced to conclude, therefore, that the most useful book for the present, and the book which will be the most profitable to the author and publisher, is one that occupies months rather than years in the making, and deals with one only of the several portions into which the science and art of electric traction may be divided.

There are, indeed, few men who are capable of writing a treatise on the whole subject, which would be at once technical, practical, sound and modern; but there are numbers who could an they would, or, were they asked, write valuable monographs on those parts of the subject with which they are most familiar. These would lose nothing of their value by being published separately, and there would be less disinclination to revise or rewrite any one of the series as it went behind the times, than if a bulky volume had to be re-printed constantly in order that it might be perennially fresh in all its parts.

The most interesting portions of the book under review are those concerned with the costs of construction and of working. Costs may keep fresh for some years, and the principles of finance for an indefinite period, but we would urge on anyone who is fired by the desire to turn out a standard quasi-technical and thoroughly commercial work, which shall not be of the easy and stultifying popular type that people are so prone to write to-day, not to waste space with tables such as can be found in several statistical year-books.

Much of the financial data has been abstracted from American sources, for in 1895 there were few electric tramways of any size or age in Europe. The author expresses the great difficulty he had to obtain any European costs of running, and he has to do what he can with such ancient stuff as the costs of the Massachusetts lines and the West End Railway Co. of Boston for periods in 1893-1894 respectively. The English examples given are Birmingham and South Staffordshire, with 25d. and 15d. per car-mile, without capital charges!

It is rather curious, too, to come across in this third part of the book a learned disquisition on the "determination of the critical point at which electric traction becomes more economical than animal traction," when no one has thought for a decade at least of building a horse line.

In the second part, devoted to the power station, the overhead line and permanent way, and the rolling stock, most of the machinery and material either has been obsolete for years, or is now much modified. Even the American rail shown is a libel. Very meagre space is given to car-sheds, and the Chicago bond is the only one mentioned.

Feeders occupy three pages, and "shamrock section" wire is mentioned as a common thing in America.

Eight cuts of long-forgotten overhead fittings are reproduced, but no section insulator appears amongst them.

Electrolysis and its prevention are dealt with at some length, chiefly by quotations from other authorities, and by a transcription of the B. of T. regulations.

All the old favourites in the way of conduit systems re-appear, including even the Love and Waller-Manville; and the Westinghouse, Vuilleumier, and Diatto surface-contact schemes are described.

Chapter IV. makes clear that the only portions of the equipment of a car which have not been subjected to radical alterations since the cutting of the blocks illustrating the chapter are the controller and trolley.

The maintenance and running of the cars is discussed in three pages, and these are not much more illuminative than the following sample:—"Every day, at the end of the day's running, the cars return to the depôt. When they arrive, the 'conducteur-électricien' [whoever he may be] should pull the trolley wheel from the trolley wire, that being done by the cord attached near the wheel."

The application of alternating currents to electric traction is "discussed" in two pages, no later method than that proposed by Ferraris and Arno being mentioned.

In the appendix, however, another 2½ pages brings the subject within call of modern times.

Chaper V., if revised, would be a valuable collection of data relating to costs of construction. The tables on pages 240 and 242, giving the range of cost of systems supporting from 10 to 400 cars are good, but would be better if all the additions were made correctly.

Although the details of the overhead construction estimates are not too clear, the figures do not err much on the big side for average construction.

Chapter VI. of the second part contains no fewer than 78 pages full of information relating solely to accumulator cars. Very interesting information too. If the South American Indian had not heard of accumulator cars already, he would put, on the strength of this chapter, all the beads he possessed into a company to run them all over his rolling pampas; but there are few Indians left who have not heard of these cars, and not even the elaborate exposition of the way in which they will recuperate from 30 per cent. to 60 per cent. of the energy used will tempt them any more than the concluding statement that Hanover is well pleased with its "mixed" system will convince the Hanoverians.

Part 4 is devoted to "Metropolitans" or city railway systems, and contains short descriptions of the City and South London, Liverpool Overhead, Chicago Elevated, Buda-Pesth Underground, and the then only projected "Metropolitain" of Paris. These descriptions are followed by a short comparison of the costs of running and amount of power required by electric and steam locomotives, which we are satisfied to take *cum grano*. Then the author gives one of the most interesting chapters in the book, especially from the historical point of view, on electric locomotives, the chief space being occupied by the Heilmann system, that boldly original project which came before its time, and was killed by the extravagance of its principles being carried out to the impossible end.

Our author, who speaks from the mists of 8 or 9 years ago, pins his whole faith to the Heilmann system for the operation of main lines. The courageous Heilmann would not have elaborated his system had he lived in the days of extra-high tensions and improved motors.

On the subject of high speeds the author is of the opinion, which recent experience has confirmed, that about 125 m.p.h. is the limiting speed, unless an especially heavy track and a line of rails, unbroken by points and branches and having no curves, is laid.

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He finds it difficult to believe that wheels of the usual composition will stand the high circumferential velocities which would be attained at a train speed of 150 miles per hour, but we think that if the speed comes, and is found to be commercially possible, the strength of materials will not be the hindering factor.

A brief sketch is given of the high-speed lines between Buda-Pesth and Vienna, and between New York and Chicago, which were projected by Zipernowski and Adams respectively, but were never laid. In the first case, the rails were to be only 6 in. high, but weighing 100 lbs. per yard, and the transmission was to be effected at 10,000 volts alternating, transformed to continuous current for supply to a centrally placed third-rail. Single cars equipped with four motors were designed for this line. In the second case, the capital required for constructing the 1,000 miles of track, including everything from permanent way to power houses and trains was estimated at £13,000 per mile. The construction would be decidedly American if this estimate were not exceeded, especially as the speed was to be 125 miles per hour and the pressure of transmission only 3,000 volts. Yet, do we not take exception to the estimate, because we are so used to the financiers and lawyers swelling capital account on other than engineering work?

Part 5, and the last, is short, and is occupied by descriptions of what a captious correspondent once objected to our calling electric canal haulage; of mining locos., and of electromobiles. The canal chapter is interesting.

The appendix brings the book rather more up to date, as it deals very briefly, among other things, with polyphase traction, the Langen suspended railway, the early Zossen trials, and the tangential traction system.

Finally, one may say that nothing quite so elaborate has been attempted in English, and it is evident throughout that nothing but immense industry and application, together with much intimate personal knowledge of the whole subject, and an almost equally valuable acquaintance with the work of contemporaries, could have sufficed to bring this book to a successful conclusion. We trust that the author has received in his own country the recognition which he certainly deserves.

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*Dynamo-Electric Machinery.* Vol. I. By Silvanus P. Thompson. London: E. & F. N. Spon, Ltd.

The continuous growth of this standard work, which now reaches its seventh edition, has rendered necessary its division into two volumes. Vol. I., which we now review, deals exclusively with continuous current machinery, alternating current plant being left over for Vol. II.

The author has embodied in this volume the small work on dynamo design, which was published about a year ago, and of which a review appeared in our issue of August 7th, 1903.

An exceedingly interesting historical review of the progress of the science of dynamo work is given in Chapter II., commencing with Faraday's disk dynamo, described before the Royal Society on November 24th, 1831.

After Faraday came a number of inventors who effected small improvements in detail, the next definite step forward being taken by Sinsteden, who suggested a dynamo with electro-magnets, the exciting current of which was provided by a small magneto machine. This principle was carried into practice by H. Wilde, who manufactured a large number of machines of this description at his works in Manchester. About 1866 the self-exciting dynamo appears to have been invented simultaneously and independently by Wheatstone, Varley, Siemens, and others. Compound winding was introduced by Varley, but appears to have been invented by him for some other purpose than that of self-regulation. In fact, the power of a compound-wound machine to automatically regulate the voltage at its terminals appears to have been rather of the nature of a discovery than of an invention.

The early form of armature was wound in sections connected to a commutator which was merely a rectifier. Pacinotti, in 1865, introduced the present system, in which the armature is provided with a continuous winding tapped off at equidistant points to a commutator having parallel bars, and so giving practically steady currents. For some reason this invention did not attract much attention, but when re-invented by Gramme, in 1870, it met with instant recognition, and was universally adopted.

In its essential principles, the dynamo of to-day is the same as that of 1870, that is to say, a machine having a continuously wound armature tapped off at equidistant points to the commutator, and having self-excited electro-magnets.

Subsequent advance has been in the direction of the discovery and formulation of the laws upon which the science of dynamo design depends, the most eminent worker in this field being the late Dr. John Hopkinson, who has, by Messrs. Parshall and Hobart, been very aptly named the founder of the modern science of dynamo design; and in the direction of improvements in mechanical design and construction, the most remarkable advance in this direction being due to our American friends, who, by the introduction of the slotted armature with carbon brushes and small air gap, have rendered multipolar construction possible, even for quite small sizes, and so have greatly increased the electrical output obtainable from a given weight of material.

The author's historical notes also deal with alternating current work. These we propose to leave over till we review Vol. II.

Following the historical notes, which we have mentioned at some length, owing to their exceptional interest, there is a chapter on the physical theory of the dynamo in which, starting with a single conductor in a magnetic field, the author leads up to the complete machine, and shows the different ways in which the excitation of the magnetic circuit may be accomplished.

In a chapter on "Magnetic Principles," the author gives a very lucid exposition of Drs. J. and E. Hopkinson's method of pre-determining the induction curve of a machine from its drawings, and gives some valuable curves of permeability, hysteresis and eddy currents.

A number of diagrams of forms of field magnets are given, the majority of which are of historical interest only. Numerical examples of magnetic calculation are given, also examples of the calculation of the leakage coefficient, or dispersal as the author prefers to call it.

Copper calculations next receive attention, and curves are given of the space factor and of the temperature coefficient for different designs of armature running at various peripheral speeds.

A short chapter is given on insulating materials, with data as to their dielectric strength.

In dealing with armature re-action and commutation, the author draws a clear distinction between reversing machines in which commutation has to be accomplished by means of brush resistance only, and machines running in one direction in which commutation may be assisted by giving lead to the brushes.

In connection with the latter class of machines it has been laid down that for sparkless commutation there should be a certain ratio between the reactance voltage, and the average voltage per segment of the commutator. The author, however, points out that the presence of an induced E.M.F. sufficient to overcome the reactance voltage, depends not on the average E.M.F. per segment of the commutator, but on the particular E.M.F. induced in the loop while it passes through the fringe of the polar field, a view which in slightly different language was expressed in the Review for January 10th, 1902.

Under the heading of sparking criterion, the author gives various rules to determine proportions necessary for sparkless commutation.

Three chapters, which will be appreciated by students, are devoted to the general theory of the dynamo. Mechanical construction and examples of modern dynamos are fully treated, and sectional drawings and photographs of machines and parts of machines in various stages of construction are given.

To draughtsmen and others engaged in the practical calculation and design of dynamos, the chapters on "Design of Dynamos" and analysis of the designs of machines by various makers, will be most useful.

A new chapter is provided on "Motor-Generators and Boosters," in which positive and negative boosters for

traction work are described, and examples are given of the various forms of automatic reversible booster for accumulator work.

A chapter on "Motors," another on "Controllers, Rheostats, and Magnetic Brakes" follow, and the work concludes with a chapter on "The Testing and Management of Dynamos," and the usual table of resistances, &c.

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*American Meter Practice.* By Lyman C. Reed. New York: McGraw Publishing Co. 1903. Price $2.

This book, as its title indicates, deals exclusively with American practice, and the meters described are those most commonly in use in America. The whole work is greatly marred by the inaccuracies and errors which it contains, notably in the chapters on the measurement of power. It is somewhat novel and original to find motors and incandescent lamps represented as absorption dynamometers, and all instruments that measure transmitted energy defined as shunt instruments.

The author's discussion of the essentials of a good commercial meter are worthy of notice; so, also, are his remarks on general management, the reading of meters and repairs.

The maximum demand and double tariff systems of charging are touched upon, and their doom within the next 10 years in America is prophesied.

The last chapter is on the elements of photometry. The only reason we can find for its inclusion in a work on electricity meters is, that the 16-c.p. lamp is stated to be still, to some extent, a meter.

The book lacks an index.

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*Electric Lighting Accounts.* By George Johnson, F.S.S., F.C.I.S., &c. London: Gee & Co., 34, Moorgate Street, E.C.

This book forms Vol. XXIX of "The Accountants' Library," and is a companion to the valuable work on "Tramway Accounts," written by Mr. McColl, and published about a year and a half ago. It deals in a clear but exhaustive manner with the manner in which the book-keeping of an electricity supply undertaking should be carried on, in order to comply with Board of Trade and public supply company requirements. The author presupposes a knowledge of single and double entry book-keeping, but he succeeds in making his meaning plain even to the non-technical reader. The accounts of an imaginary company are taken, and extracts are given from the various books and entries, showing how the different payments and receipts should be allocated.

The chapter on Depreciation and Renewals is very short, occupying less than two pages. It does not in any way discuss the policy of the question, but merely gives general percentages which it suggests as useful guides.

These figures vary from 2½ per cent. for buildings, to 10 per cent. for accumulators, 7½ per cent. being the rate for generating plant, 7½ per cent. to 10 per cent. for engines and boilers, and 5 per cent. for cables.

These figures are distinct from the sums required for renewals and repair of plant from time to time. It is notorious that the depreciation allowances made by many undertakings are far too small, and it would be a good portent for the real prosperity of the supply industry if the author's suggestions were carried into practice, and sufficient sums were written off the capital account year by year to provide against the inevitable time when the depreciation will have so diminished the value of the plant that the capital cost must practically be written down to its scrap value.

## THE BEST FORM OF CURRENT FOR LIGHT RAILWAYS.

Of the papers read at the thirteenth general meeting of the International Union of Tramways and Light Railways held at Vienna one of the most important, as touching a question which has sprung up within the last year or two, is M. Pforr's report on the best form and pressure of current for light railways or interurban tramways. Two years since, no matter how the current was transmitted, the motors were fed by direct current at 500 to 700 volts, with the rarest exceptions, and those in the nature of novelties, which were looked on by the bulk of engineers as experimental. Now engineers throughout the world are anticipating the sigh of relief which will escape them when they are satisfied, after sufficient trial, that the simple single-phase current is available for traction work, and, moreover, presents certain advantages over any existing system of outside transmission.

We give below a free translation, somewhat curtailed, of M. Pforr's report. To English readers it may be necessary to introduce the author as the chief engineer of the A.E.G., of Berlin.

It is recognised nowadays that traction on light railways either by steam locomotives or by continuous current at 500 volts is not at all perfect. Small quantities of goods cannot be dealt with economically by the former, and the latter will not do for heavy or long-distance traffic. In any event, steam traction is not so convenient as electric traction for many well-known reasons. In endeavouring to overcome the disadvantages of these two systems, the old automobile steam coach has been rejuvenated, while electrical engineers have tried accumulator cars with small success up to the present. The reasons why neither have succeeded very well are that hitherto no really economical boiler and engine have been made in sufficiently small sizes, and that accumulator cars weigh so much and are so costly to maintain.

Electricians have been striving very energetically after new methods lately.

The chief reason for using electricity is to get the benefit of large, concentrated power stations, and it follows that electricity is not a suitable force for lines supporting only one car, or a few cars on a long track. No economy can be realised by centralising power production unless the consumption is great. It is then possible to install large sets, working economically and requiring a comparatively small staff, and the economy will increase with the number of cars run.

Light railways cannot be run often with 500 volts, for as a rule they are long and have nothing like the traffic of a tramway, so that the feeding problem alone is enough to spoil such schemes. In the case of tramways, the cost of equipping the line electrically including feeders, and perhaps sub-stations, boosters and batteries is between 20 and 30 per cent. of the total electrical equipment including rolling stock and power stations; and in certain circumstances this cost may be increased three or four times for a suburban line.

The cost of transmission decreases as the current is reduced, and as energy can be transmitted at small or great current density according to the pressure, the cost will be decreased as the pressure is raised.

Sometimes it has been found economical to raise the pressure supplied by existing plant, and this has been done up to 650 volts without serious alterations being made, but the problem can only be solved satisfactorily by raising the pressure considerably.

For the same expense in copper, one can double the area served by the generating station by doubling the pressure. But the cost of transmission does not depend only on the expenditure on copper. In fact, this is only one-third or a quarter of the total, the greatest part of the cost being in poles and insulation, and this increases proportionally to the length of the line.

Light railways differ from urban tramways in being not only much longer, but in running much heavier trains, and taking much more current. It is evident, therefore, that to put light railways on the same footing as tramways, commercially, much higher pressures must be used, and in America this fact has been recognised in the construction of a large number of inter-urban lines.

So long as cars had to be equipped with direct-current motors it was necessary to transform the high-tension current to continuous current at 500 volts with greatly increased cost, not only in construction, but also in working; and, as it is not practically possible to transform continuous current without making use of motor-generators, the energy losses and the cost of maintenance and supervision are great.

To transform the pressure of alternating current is simple. Stationary appliances requiring no attention and wasting little energy are required either to increase or diminish pressure. Obviously, therefore, alternating current is the best for transmission of energy.

After much experimenting both polyphase and single-phase motors are practical facts. The monophase motor requires only two conductors, and the polyphase more according to the number of phases. The triphase motor calls for three wires, thus being next to the single-phase motor in simplicity. Naturally, the motor requiring the least conductors is the one to be preferred for traction, but up to quite recently there was no single-phase motor which would start on load. This was possible only with a polyphase motor, and that fact explains why the first experiments in high tension traction were carried out with the latter; as, for instance, on the Burgdorf-Thun and the Valtellina railway, and the experimental high-speed railway as Zossen.

Recently, however, single-phase motors have become available for traction, and are in use already on the Prussian railways from Niderschöneweide to Spindlersfeld, and on the line through the Stubai Valley, the first having been opened for working on July 4th this year, while the second has been opened recently.

At the same time that these new departures are taking place, improvements are being sought for and made in high-tension continuous-current traction. For instance, Thury has installed his system with four motors in series, across 2,400 volts continuous current on the St. Georges de Camiers—La Wure line, but since this installation was made it has been necessary to put up another wire on account of the danger of breaking such H.T. currents during speed regulation, thus reducing the tension between either conductor and

earth to 1,200 volts. Oil immersed switches are used for breaking these currents.

Both triphase and monophase currents enable us to install generators for any pressure, and to transform to high tension, and again to whatever tension we desire on the cars. To do this does not require specially costly machinery or much attention, which cannot be said in the case of continuous current. We may regard these alternating systems, therefore, as the more economical, and may compare them together.

In the first place the triphase system requires one wire more than the monophase, but the advocates of the former assert that this is offset by the greater maintenance required by the monophase system on account of the motor having a commutator. Commutators, in fact, were the delicate points in electric traction in the first place, but these disadvantages have disappeared since a sparkless motor has been designed, and the new mono-phase motor is just as free from sparking as the continuous-current motor, and it has an advantage over the latter in that its commutator works under less pressure, and is, therefore, easier to maintain. From a practical point of view there is no difference in maintenance between the two; certainly not enough to make any difference one way or the other in a comparison of the two systems. The absence of a commutator would be a disadvantage on many light railways, for the cars often might have to run over lines already equipped on the direct current system, and in that case it would be possible only for a motor with a commutator to do the work.

With respect to the price of equipment, there is not much to choose between three-phase and single-phase, and this applies equally to the generating station.

It is necessary to explain that the triphase motor is analogous in certain respects to a shunt-wound continuous-current motor. For instance, the three-phase motor tends to run at a constant speed whatever the grade may be, and this is a disadvantage as the current consumption is so much more on hills than on the level. On the other hand, the monophase motor has, just like the series direct current motor, the advantage of working at a decreased speed when the tractive effort becomes greater. The consumption of energy, therefore, on hills does not rise in the same proportion as it does with three-phase motors. It follows that the load on the power station is more uniform. If we compare the power consumption of the motors themselves, we find again the triphase motor at a disadvantage for the reason that the regulation at starting is obtained by means of resistances, or by connection in cascade, thus causing great losses of energy.

As the monophase motor is started by means of a transformer, the losses are of little importance.

Finally, the monophase motor has this great advantage over the triphase that it will work with a heavy drop in line pressure, whereas the latter stops when pressure is reduced a little.

With regard to the other features of electric traction, the two systems are alike. With both, energy may be regenerated on descents; but a discussion of this matter of regeneration cannot be undertaken here.

We see, therefore, that the triphase motor presents nothing but disadvantages in comparison with the single-phase motor, and may be dismissed from our comparative study. The employment of three-phase motors for traction is only justified in particular cases, as, for instance, where it is necessary to make use of an existing station, or where the cost of running is not material.

It remains now to compare the monophase with the H.T. direct-current motor. This is not such a simple matter, and it is well to begin by examining the peculiarities of each. The only monophase motor which has been tried in actual practice is the Winter-Eichberg, although several others have been experimented with in laboratories or on trial tracks, as, for instance, the Lamme and Finzi motors, which are practically alike; and if one pictures a continuous-current motor fed by an alternating current, one sees broadly their principle. Quite different is the Winter-Eichberg. A special current passes through the stator, and another, derived from the first through a transformer, goes through the rotor. The pressure in the rotor is for this reason independent of the field pressure, and it is thus easy to regulate the speed by putting a higher or lower pressure across the rotor. As other systems are insufficiently known to include in this report, the expression single-phase motor will refer to the Winter-Eichberg.

A comparison between single-phase and continuous-current motors is only in favour of the latter on the points of weight and efficiency. This arises from the fact that a monophase motor is separately excited while a continuous-current motor excites itself with relatively small losses. It follows that the losses due to the Joule effect are nearly twice as great as in a continuous-current motor, resulting in a decreased efficiency of from 4 per cent. to 5 per cent. Then, again, when the periodicity is as high as 40 to 50, the iron losses are increased, while at frequencies between 16 and 25, these losses come down to the level of the direct-current motor. The lower efficiency and the unfavourable conditions of working, necessitate an increased weight of from 10 per cent. to 20 per cent., according to the frequency, the weight increasing as the frequency rises. On the other hand, the alternating motor scores over the other in the matter of starting, so that the smaller efficiency of the one, and the starting losses of the other practically balance.

The monophase controller is similar in all respects to the usual 500-volt tramway controller, and the remainder of the equipment is the same in both cases.

Multiple unit trains can be equipped equally as well with single-phase as with direct-current motors, a statement which has been proved at Spindlersfeld. The line may be fed at 500 volts, or at 10,000 volts, for in either case the motors will be fed at 200 volts only, the reduction being effected on the car by transformers.

The highest pressure hitherto employed with ordinary apparatus is 800 volts on the Berlin Elevated, but Thury who uses a pressure of 1,200 volts has tried contact breakers in oil, which naturally take up much more room, and cost more than the ordinary type. The working of these high-tension controllers is, moreover, not without danger, and it is still more necessary to prevent public access to live parts than is the case with either the continuous current or monophase system.

Light railways may be divided into two main categories: the first comprising those installations on which it is possible to use 1,200 volts or less, and to transmit at this pressure. Such lines will not have their termini further than 15 to 20 km. from the power station, and will run only light trains. The second category will contain lines to which energy is transmitted at a tension exceeding 1,200 volts, in order to supply longer lines and heavier trains.

In the matter of economy of installation the monophase system is simplified by reason of the current being supplied at high tension right up to the car, although one would naturally avoid introducing pressures in excess of 6,000 volts into the cars for the sake of the cables. Greater pressures will be required rarely, and if they are the difficulty can be overcome by means of stationary transformers at small cost.

While continuous-current systems require expensive sub-stations they have an advantage over alternating systems in being able to use buffer-batteries, thus reducing the size of the generating station; but, with respect to line equipment, there is no difference in cost between the two systems.

If the cost of building sub-stations for continuous current is put against the greater cost of equipping the cars for alternating current, it is found that the one system costs no more than the other, but when it comes to working, the monophase scores on account of the absence of sub-stations.

It may be remarked that Thury's system provides a pressure of 2,400 volts without sub-stations, but it has been explained already that two wires are used, each at a potential difference of 1,200 volts, relative to the rails, so that what is gained by the absence of sub-stations is lost by the second wire.

It follows, then, that this system cannot hold its own against the monophase system from the point of view of line construction. It should be noted, however, that Thury launched his system before the inception of the monophase system.

When the railway system calls for a pressure of less than 1,200 volts, then only can continuous current be utilised with advantage, and it will become more favourable as the pressure is reduced. From 600 to 700 volts the continuous current motor is undoubtedly the best.

When, in a continuous current system, it is necessary to employ a pressure between 700 and 1,200 volts, it becomes essential to use special apparatus, and the cost of motors goes up a little, that of the controlling devices much more.

Further, there is much more danger, both for the operators and for the passengers. The extra cost of rolling stock for monophase traction is not greater than that for continuous current at lower pressures, and further, the monophase system affords greater security.

The solution of the problem should be studied for each particular case.

When the line passes through narrow streets, it is difficult to obtain permission to equip it with H.T. direct current, and preference will be given to alternating current, for that allows with ease either the reduction of voltage over the whole line, leaving the feeders at high pressure, or the reduction of voltage on those particular portions of the line only which are dangerous.

The Winter-Eichberg motor will work equally well, whether current passes direct into the rotor or whether the stator takes transformed current. If, for example, the rotor is designed for 200 volts, it is possible to work on country lines at a pressure of 1,200 volts, and to have only 200 volts on the trolley wires in narrow streets, or at 400 volts if two motors are in use. This property of the monophase motor of adapting itself to all conditions of pressure, will give it the preference over the continuous-current system.

The disturbances caused by the two systems are unlike. Continuous current makes itself felt among the gas and water pipes underground, but is less troublesome for telegraph and telephone circuits; while alternating current will not attack the pipes, but disturbs the telegraph wires more.

On the Spindlersfeld line these disturbances are felt only in a small degree, and the noises which are heard arise chiefly from the collector. As these disturbances can be kept within permissible limits, it is unnecessary to consider them when studying the problem.

## THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

### A Slight Improvement in Business and Results.

The August issue of the official labour organ which was first established by the German Imperial Home Office a few months ago, and which is equivalent to the Board of Trade *Labour Gazette*, records an improvement in July in the "not unfavourable situation of business" as far as concerns most branches of the electrical industry, the only reduction being in the demand for insulating

materials. An increase took place in the manufacture of cables, accumulators, dynamos, motors and transformers, and a larger turnover was also effected in other branches, whilst at the same time no noteworthy alterations are reported as having occurred in the rates of wages.

### German Works.

The report of the Lahmeyer Co., of Frankfort-on-Main, which has again entered upon the dividend stage after a lapse of two years, states that the degree of employment gradually improved during 1903-4, although it was only in the second half of the year that a surplus on working was obtained. It will be remembered that the company in the previous year absorbed its so-called trust—the German Company for Electrical Enterprises—and the latter's various central stations, and these and other undertakings are worked or leased by the Lahmeyer Co. Thus the accounts, which show gross profits amounting to £186,114 as compared with £115,211 in 1902-3, relate both to manufacturing operations and yield on investments, but the two items are not separately indicated. The net profits total £30,831 as against a loss in the two preceding years, and a dividend has been declared at the rate of 2½ per cent. This compares with 10 per cent. paid in 1900-1, and 11 per cent. in each of the two previous years. The directors' report states that the delivery of 2,772 generators and motors, of a total output of 111,000 H.P., was the largest since the formation of the company, and the branch companies in Italy and England, although they have not yielded any dividend, have materially contributed towards the increase in the volume of business. As to the future outlook, the report observes that development largely depends upon the general shaping of the business and industrial situation. The orders on hand promise to find full employment for the workshops during the greater portion of the current year, and it is pointed out that the trend of affairs lies in a large increase in independent lighting and power installations, as large municipal stations and tramways, and large industrial installations are being proceeded with to a less extent than formerly.

The report for 1903-4 of Brown, Boveri & Co., of Mannheim, which is a subsidiary of the well-known Swiss company bearing the same name, states that the workshops were actively employed during the year, and it was necessary to work night shifts for some time. The paid-up capital amounts to £150,000, and the gross profits on manufacturing totalled £39,073, as compared with £29,401 in the preceding twelve months. After meeting working expenses and cost of repairs, and providing £11,076 for depreciation—wear and tear are calculated on the same liberal basis as is adopted by the Swiss parent company, to which reference will subsequently be made—the accounts exhibit net profits of £7,486, as against £7,113 in 1902-3. A dividend has been declared at the rate of 4 per cent., being the same as in the two preceding years. The report states that prices showed a disposition to improve towards the end of the year, and the orders received for steam turbines on the Brown-Boveri-Parsons system numbered 69, representing a total of 50,535 H.P. The accumulation of orders has necessitated the doubling of the capacity of the workshops, and plant is being installed for the testing of turbines in connection with this extension, the greater portion of which will be ready for manufacturing purposes in the autumn of the present year.

Among other German companies may be mentioned the German Cable Works Co., of Berlin-Rummelsburg, which proposes to pay 3 per cent., as against nil in 1902-3. On the other hand, the Westinghouse Electricity Co., of Berlin, which has not paid any dividend since its foundation in 1901, has incurred a loss during 1903, which increases the total deficit to £24,150, on a paid-up capital of £25,000. The Pfluger Accumulator Works Co., of Berlin, which has a share capital of £70,000, has closed the past year with a profit of less than £10, and it is, therefore, unable to make any distribution, as in the year 1902-3.

### Swiss and other Companies.

The directors of the Zurich Bank for Electrical Enterprises have presented an encouraging report for the year 1903-4. It may be remembered that the greater portion of the bank's share capital is held by the Berlin Allgemeine Co., and until about a year ago the institution was mainly concerned with the financing of undertakings carried out by the A.E.G. Since then the bank has acted as a general financial organisation for the electrical industry, and has opened an office in Berlin in connection with the extension of business. The share capital of the institution amounts to £1,320,000, and in addition to this a bond issue of £1,280,000, which has been slightly reduced in a gradual manner during the past three years, is in circulation. The yield on the company's investments during the past year has been more satisfactory, and the result is shown by an increase of £15,243 in the net profits, which amount to £113,331, as compared with £98,088 in 1902-3. This improvement allows of an increase in the dividend to 7½ per cent., as against 6½ per cent. in the previous year, and 6 per cent. each in 1901-2 and 1900-1. The report of the directors states that the crisis in the electrical industry has, on the whole, been overcome, although the favourable conditions which formerly prevailed for individual businesses have not been restored. As far as concerns the various undertakings in which the bank is interested, the report observes that these have further developed in a satisfactory manner during the year, although not to the same extent in each case. The companies in which the bank participates are located in various European countries and South America, and the Seville Tramways Co. and the Chilian Electric Tramways Co. are also included in its list of investments.

The Swiss undertaking of Brown, Boveri & Co., of Baden, shows further progress during 1903-4, and this is all the more satisfactory by reason of the fact that the improved financial results are almost entirely due to an increased return on manufacturing operations. Of the company's total share capital of £500,000, shares to the extent of £225,000 have been exchanged for £175,000 in shares of the Berlin Allgemeine Co. during the past year, and a community of interests has thereby been brought about which will obviate competition between the two concerns, and at the same time bring into operation an interchange of experience and appliances. In addition to the ordinary capital, an obligation loan of £200,000 has been raised for the purpose of providing additional funds and the redemption of the old loan of £60,000. The company, as in the previous year, has written off for depreciation, 5 per cent. on buildings, 10 per cent. on railway track and machinery, 40 per cent. on tools, 30 per cent. on foundry tools, 20 per cent. on office furniture, 25 per cent. on factory furniture and electric light installation, and 100 per cent. on patterns and patents. After providing for these charges and meeting working and all other expenses, the accounts indicate net profits amounting to £54,225, or an increase of £12,507 over 1902-3. It is proposed to pay a dividend at the rate of 9 per cent., as compared with 7 per cent. and 5 per cent. respectively in the two preceding years. The directors' report states that the workshops were very well provided with employment during the year, and special attention is being devoted to the electrical transmission of power at high pressures. In this connection it is mentioned that installations of this kind have recently been completed where the pressure ranges from 36,000 volts to 40,000 volts. In regard to electric traction on railways, the company records the receipt from the Adriatic Railway Administration of an order for the delivery of two rotary current locomotives, each of 1,000 H.P., for the Valtellina railway. The trade in turbines has shown an extraordinary development, and of the total of 225,000 H.P. on order in July, no less than 40,000 H.P. represents an order for the St. Denis generating station of the Société d'Electricité de Paris. As far as the current year is concerned, the report remarks that exceptionally large contracts are in hand, which will fully occupy the shops during the entire 12 months, and the financial results are, therefore, expected not to be less satisfactory than those for 1903-4.

The Swiss Co. for Electrical Industry, of Basle, which is closely associated with the Siemens & Halske Co., of Berlin, is another investment company which has improved its position in 1903. It has a share capital of £400,000 and a bond issue of £1,200,000, and the gross profits are nearly twice the total which was realised in 1902. After meeting interest charges and working expenses, writing off £4,000 for depreciation of securities, and placing £22,000 to a reserve fund for syndicate investments, the accounts show net profits amounting to £15,134, as against £424 in 1902. The sum available for disposal has allowed of the payment of a dividend at the rate of 3 per cent., whereas no distribution whatever was possible in the two preceding years. The report of the directors states that the company devoted its attention during the year to the further development of the undertakings in which it is interested, and abstained from embarking upon new enterprises, whilst, at the same time, a favourable opportunity was afforded for disposing on advantageous terms of shares in one concern of the book value of £57,600. In addition to this the company concluded an agreement with the Mexican Electric Light and Power Co., of Montreal, Canada, in regard to the shares held in the Mexican Electric Works. The transaction was completed partly by a cash payment and partly by the acceptance of 5 per cent. gold bonds in the Mexican Electric Light and Power Co. and an equal number of ordinary shares ranking as fully paid. The other undertakings in which the company is interested are lighting, power, and tramway enterprises in Europe.

The Compagnie Francaise des Cables Télégraphiques, of Paris, has terminated the year 1903 with a deficit of £26,363, as compared with a deficiency of £12,698 in 1902. The company has a share capital of £537,000, and the obligations amount to nearly £2,000,000. In conformity with the existing convention with the State, the Government has granted an advance of £32,000, and the difference between this sum and the past year's deficit has been transferred to the contingency fund. The convention also authorised the cable company to issue £320,000, in 3½ per cent. obligations, but it has been impossible to find subscribers for the bonds. In order, however, to render possible the carrying out of the proposed scheme of financial reorganisation, and at the same time to promote the interests of the State, a new convention has been concluded which provides, among other matters, for the issue under Government guarantee of a loan of £600,000 in 3 per cent. obligations.

The Russian Tudor Accumulator Co. has distributed a dividend at the rate of 8 per cent. for 1903, as compared with 6 per cent. in the previous year, and nil in 1901. The dividend absorbs the sum of £4,800. On the other hand, the concerns established in Russia by other German companies, show unsatisfactory results. For instance, the Siemens & Halske Co., of St. Petersburg, which has a share capital of £700,000, earned net profits amounting to £3,478 in 1903, but this has been applied to a reduction of the deficit brought forward from the preceding year, which still stands at £16,341. The Russian Allgemeine Electricity Co. realised gross profits of £24,100 in 1903, which was the second year's trading, and the net profits reached £1,100. Of this sum the company, which has a paid-up capital of £100,000, has placed 5 per cent. to the reserve fund, and carried the balance forward. The Schuckert Co. has closed the year with a deficit of £1,453, which thus increases the total deficiency to £9,504. The Volta Co., of Reval, which is one of the few independent Russian manufacturing companies, has again proved to be unremunerative. Its accounts for 1902-3 reveal a loss of £3,944, which advances the total deficit to £17,550, on a share capital of £150,000.

## BUSINESS NOTES.

### Electrical Wares Exported.

| Week ending September 1st, 1903. | | Week ending August 30th, 1904. | |
|---|---|---|---|
| Aden | Value £24 | Adelaide | Value £272 |
| Amsterdam | 50 | Alexandria | 142 |
| Auckland | 134 | Amsterdam | 90 |
| Beira | 19 | Antwerp | 275 |
| ,, Teleg. mat. | 181 | Bombay | 46 |
| Brisbane | 106 | ,, Teleg. mat. | 138 |
| Buenos Ayres | 20 | Calcutta | 173 |
| Calcutta | 339 | ,, Elec. machinery | 877 |
| Cape Town | 134 | Cape Town | 7 |
| Channel Islands | 36 | ,, Elec. machinery | 51 |
| Christchurch | 38 | ,, Teleg. mat. | 675 |
| Colombo | 312 | Christiania | 15 |
| Copenhagen. Teleg. mat. | 53 | Cologne | 35 |
| Delagoa Bay | 48 | Colombo | 36 |
| Durban | 626 | Durban | 689 |
| ,, Teleg. mat. | 452 | ,, Teleg. mat. | 75 |
| East London | 379 | East London. Elec. machinery | 590 |
| Flushing | 56 | Genoa. Teleg. mat. | 35 |
| Gibraltar | 45 | Gibraltar | 81 |
| Libau | 70 | ,, Teleg. mat. | 15 |
| Melbourne | 70 | Gothenburg | 9 |
| Montreal | 21 | Hamburg | 7 |
| Perth | 18 | Hong Kong. Elec. machinery | 24 |
| Port Elizabeth | 76 | Lisbon | 50 |
| Progresso. Telephones | 285 | ,, Teleg. instruments | 65 |
| Rangoon | 12 | Madras | 218 |
| Rio Janeiro | 247 | Melbourne | 81 |
| St. Petersburg | 24 | North Atlantic. Teleg. cable | 16,000 |
| Saigon | 40 | Otago. Elec. machinery | 106 |
| Santos | 383 | Perth | 789 |
| Singapore | 49 | ,, Elec. instruments | 69 |
| ,, Teleg. mat. | 43 | ,, Elec. machinery | 402 |
| Stockholm. Teleg. wire | 52 | Port Elizabeth | 418 |
| Sydney | 670 | Rangoon | 22 |
| Toronto | 85 | Rio Janeiro. Telephones | 160 |
| Wellington | 1,045 | Rotterdam | 12 |
| Yokohama | 645 | Shanghai. Teleg. mat. | 68 |
| ,, | 20 | Singapore. Elec. machinery | 230 |
| | | Sydney | 2,720 |
| | | ,, Elec. machinery | 449 |
| | | Wellington | 449 |
| | | Yokohama | 30 |
| Total | £6,907 | Total | £26,600 |

### Foreign Goods Transhipped.

| | | | |
|---|---|---|---|
| Bombay. Elec. mat. | Value £75 | Brussels. Elec. mat. | Value £38 |
| East London. Elec. apparatus | 255 | Cape Town. Elec. machinery | 750 |
| Santos. Elec. mat. | 86 | Durban. Elec. lamps | 323 |
| Sydney. Elec. mat. | 85 | Melbourne. Elec. lamps. | 290 |
| Total | £502 | Value | £1,396 |

**Australian Trade Marks.**—Messrs. W. P. Thompson and Co., patent agents of Liverpool, write:—

"Through the courtesy of an Australian Member of Parliament we have received an advanced copy of the new Trade Marks Bill for an Act to cover the six States forming the Commonwealth, namely, New South Wales, Victoria, Queensland, South Australia, West Australia, and Tasmania.

"The Bill which has just been introduced into the Senate, is the complement of the Fradulent Marks Bill. The new Bill states at the outset that, subject to certain limitations imposed, the common law of England relating to trade marks shall apply throughout the Commonwealth, and the States Trade Marks Acts cease to operate further than that the State Trade Marks Act under which a trade mark was registered shall continue to apply to that trade mark, so long as registration under that Act remains in force. The registration of a trade mark under a State Act is to cease either at the expiration of 14 years from the commencement of the new Act, or at the time when it first becomes liable to removal from the register, whichever event first happens.

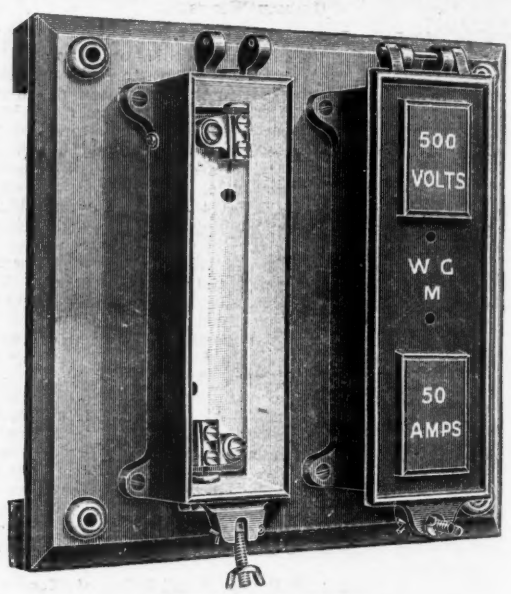
"Trade marks already registered under State Acts may be federally registered. Where however the trade mark or a nearly identical trade mark is common to the trade in another State, it may be registered with an exception as to that State. The administrative sections of the Bill make the Minister of Customs the political head of the administration, with a Registrar of Trade Marks as executive officer. To the minister and his subordinate all functions performed by State ministers and officers in relation to trade marks, together with all records, are to be transferred. The essential particulars of a registrable trade mark are practically identical with the British Act. The additional matter which may be added to the essential particulars registered is limited to letters, words, or figures. No trade mark may contain the word Royal or a representation of the Royal Arms or Crown, the national flag of Great Britain, or that of the Commonwealth, or of any Australian State. Elaborate precautions for protecting owners against infringement are embodied in the Bill.

"International arrangements for the protection of trade marks are provided for, in the final clauses of the Bill. The protection afforded must, it is indicated, be reciprocal. If a foreign country is shown by an order of the Imperial Executive Council, to be prepared to protect British trade marks in return for protection being given to its trade marks, then the Commonwealth Government may enter into a similar arrangement."

**Germany.**—A company has just been formed in Dresden with a capital of £3,500 to be known as the Dresdner Accumulatorenwerke Gesellschaft, to acquire from Herr Max Schneider, and exploit certain patents relating to accumulators.

**Exports of Electrical Machinery.**—A steady improvement is taking place in the export trade in British electrical machinery. The shipments during July attained a value of £49,495, the largest total so far recorded for any month, and bringing the aggregate for the seven months ending with July up to £264,349, as contrasted with £258,807 in the first seven months of 1903.

**The "Vitro" Fuse Box.**—The above is the designation of a new line of fuse boxes, the interior of which are lined with vitreous enamel, which is claimed to be an ideal insulator for this purpose. This lining has a similar appearance to white porcelain, it stands the heat and compression much better than asbestos,




The "Vitro" Fuse Box.

which has frequently proved unsatisfactory owing to its retention of damp and liability to buckle. This special lining is provisionally protected, and the fuse boxes so lined are in all cases suitable for voltages up to 500. Messrs. Ward & Goldstone are the manufacturers and patentees, with address at Dutton Street, Strangeways, Manchester.

**Car-lighting Resistances.**—Messrs. the A.E.G. English Manufacturing Co., Ltd., send us particulars of their car-lighting resistances, in which they make use of the high temperature coefficient of iron to keep the current constant, within a certain range of voltages. These resistances are made for four currents:—0·4, 0·8, 1 and 1·2 amperes. Several trains on the Prussian State railways are equipped with this system; a battery of 30 cells being charged from a dynamo on the locomotive. No accumulator switches are employed, the regulating of the pressure being done by the car-lighting resistances only, of which there is one to every incandescent lamp. The pressures obtained vary from 75 to 55 volts. The resistances, therefore, have to regulate 20 volts. They, however, do not regulate from 0 to 20 volts, but from 10 to 30 volts. In the above-mentioned case 45-volt lamps have to be used, so that at the lowest (45 + 10 = 55 volts) as well as at the highest pressure (45 + 20 = 75 volts), the resistance remains inside its range of regulating capacity. The variation of current which our car-lighting resistances are subject to, does not exceed 4 per cent. either way, *i.e.*, a 1-ampere 20-volt resistance will, at 10 volts, not take less than 0·96, and at 30 volts not more than 1·04 amperes. For tramways, where the voltage varies from 450 to 550 volts, the resistances regulate from 50 to 150 volts. Four incandescent lamps of 100 volts are, therefore, used in series. The tramway resistances are made for 0·4 ampere only. The life of the car-lighting resistances is, under normal conditions, several thousand hours.

**Annual Outings.**—The employés of Messrs. W. P. Theermann & Co., of Manchester, had their annual Picnic on Saturday. A special saloon, the "Electric Spark," conveyed the party to Chester, where dinner was served, and an electric launch subsequently took them to Eaton Hall. During the past season upwards of 17,000 lights have been installed by the firm, in addition to some 40 dynamos, 15 steam engines, and several gas engines and motors. Messrs. Theermann now have in hand orders for upwards of 5,400 lights.

On Saturday last, in splendid weather, a party of members of the Electrical Trades Union, went for a day's outing at Broxbourne. Luncheon was served at the Bull, followed by a cricket match "Married *v.* Single," but as the single members of the Union were not in sufficient strength, sides were chosen, Mr. Jessop's team winning by 90 runs against 42 obtained by Mr. Robert's men. After cricket, dinner was provided at the same hostelry. The party subsequently went for a drive through the surrounding districts.

**Rubber Prices.**—The India-Rubber, Gutta-Percha and Telegraph Works Co. has issued a circular, dated September 1st, announcing advances in the prices of rubber goods, varying between 2½ per cent. and 5 per cent.

**Australia.**—The Australian Customs authorities have lately given a decision to the effect that "electrical materials—sparking plugs fitted with or without porcelain, being part of a spark coil" are dutiable at the rate of 12½ per cent. *ad valorem*.

**New Factory.**—It is reported that efforts are being made to establish an electrical engineering works at Stamford. A Derby firm is negotiating with Lord Exeter for a site for the buildings.

**Single-Phase Tramways.**—The following translation of an extract from *Electro*, for July, has been sent to us. It relates to some practical tests of alternating current single-phase commutator tramway motors made at Liège, and says:—"From some practical tests recently made at Liège by the International Electrical Engineering Co., it would appear that the future belongs to the single-phase motor with a commutator. Numerous trials of this type of motor have been made on such machines, and the subject has been frequently discussed in the technical press. For the purpose of testing the system in a practical way, the International Electrical Engineering Co. built a single-phase commutator motor capable of giving 25 H.P. when running at 550 revolutions per minute, with a frequency of 20 cycles. After a satisfactory test had been made at the works, the motor was fitted to one of the cars of the Liège tramways, and put into use. An auto-transformer, consisting of a static transformer with a single winding, is used for starting, and a special controller constructed to work either with continuous or alternating current, controls the current taken at starting. The total weight of the car is eight tons. A series of tests was made with single-phase current on April 20th, and the same tests repeated with continuous current on April 23rd, the single-phase and continuous current being measured by a special meter fixed in the car. The result was, that in the case of the single-phase motor, the total consumption of energy was only two-thirds of that of the continuous current motor. When to this economy is added the advantage of transmission at high voltage, and the facility and economy of transformation by static instead of rotary transformers, it is obvious that the single-phase commutator motor is very much superior to the continuous current tramway motor at present employed, and it is destined to supersede it. These experiments are the first which have been made in a practical way in Belgium." This is interesting in connection with the article on page 373.

**Fire.**—The fire which occurred at the works of Messrs. J. G. Statter & Co., at Birmingham, on 25th ult., was quite a small affair; the damage was slight, and was entirely covered by insurance.

**Catalogues and Lists.**—A number of new illustrated pamphlets have just been issued by the British Thomson-Houston Co., Ltd. No 170 is devoted to electrically-operated cranes, and shows some good half-tone illustrations of such cranes supplied by the company for the Carville power station, the Manchester Ship Canal, the Great Northern and City Railway, &c. No 171 describes the B.T.H. Meridian lamp, which has already been particularised in the columns of the Electrical Review. No. 169 gives a description of the B.T.H. single-phase induction motors; and No. 84 is a price-list of fusible cut-outs and fuses.

A new price-list of miniature arc lamps has been brought out by the Union Electric Co., Ltd., of Queen Victoria Street, E.C.

The British Aluminium Co., Ltd., has published some new price-lists of prices of aluminium wire, sheets, tubes, and aluminium alloys. A table of some of the large American users of aluminium wire for electrical power transmission purposes is given, showing the power transmitted over the lines, the voltage, the length of line, gauge of wire, weight of wire in tons, and a few general remarks. A smaller list gives such particulars as are available respecting the users of aluminium wire for similar purposes in England and on the Continent.

A copy of Messrs. W. H. Bailey & Co.'s latest catalogue dealing with compressors and vacuum pumps has been received. Messrs. Bailey are manufacturing under the "Köster" patents, under which they hold the sole licence for the United Kingdom. The catalogue, which carries a very good style, has many sectional diagrams and half-tone illustrations. A description is given of the patent positive type of valve gear in the compressors, together with a recital of its advantages over some other gears. The valve-gear of the vacuum pump is also detailed, and the machines are stated to attain an exceedingly high mechanical and volumetric efficiency. The compressors are made on the single and multiple stage compound inter-cooling systems, and the vacuum pumps are made on the single and double stage systems, all machines being arranged either for belt, steam, or direct electric driving. The uses to which the plant described may be put are mentioned, and some notes discuss the advantages obtainable by means of multiple compression. Tabulated data respecting standard sizes are given.

The August "Progress" sheet of the General Electric Co., Ltd., contains particulars of several new lines. A new type of "Stanley" measuring instrument, known as the "Aperiodic" has been designed to suit the requirements where absolutely dead-beat instruments are a necessity. It is claimed that on fluctuating loads, readings may be made with strict accuracy. Another addition to the list of "Freezor" fans is a porthole fan, which is being supplied in two sizes, viz., 12 in. and 16 in., with a current consumption of 55 and 110 watts respectively. A "Link" type of switch is illustrated with a detachable key, or lever. This will be found useful where switches are likely to be tampered with. The switch is minus the usual "knob-headed" lever, and cannot be thrown on or off without the key; the latter is made to fit any key ring. The company are now making oval tube "Union" conduit, in three sizes, both close joint and brazed.

From Messrs. Ferranti, Ltd, we have received a copy of their new catalogue, No. 12, describing their indicating wattmeter for single and multiphase alternating current circuits, and giving prices and diagrams of same.

Messrs. Austin Walters & Son, of Manchester, have issued a circular describing their stage plugs, stage arcs, &c.

A list of multi-carbon and other electric arc lamps for photographic, stage, medical, and general lighting, also reflectors and stands, has been received from the Boardman Electrical Patents Co., Ltd., of Southwark Bridge Road, S.E.

The United Telpherage Co., of Westfield, New Jersey, has sent us a couple of interesting pamphlets, one describing its system in use at some large American cocoa works, and the other showing its application with electric hoists in a gas works for hoisting, conveying, screening, depositing, and storing coal and coke, and removing ashes.

From the New Brotherton Tube Co., Ltd., of Excelsior Works, Wolverhampton, we have received a new illustrated price list (No. 5) of the "Excelsior" system of electrical conduits. The company supplies the ordinary close-jointed conduit, but, as a result of the demand for a screwed tube, is supplying solid-drawn tubes in both heavy and light gauges, in place of the brazed qualities; it is claimed that an entirely seamless and watertight tube is thus obtained. The conduits are supplied either for slip joints or screwed. Light gauge screwed and heavy gauge tubes, also a cheaper smooth bore welded conduit, are detailed. In regard to inspection fittings which are essential to a draw-through system, the company offers two types, the Excelsior registered split type series of bends, tees, junction boxes, &c., more applicable for surface construction and in positions free from damp; and the Excelsior watertight inspection fittings, in conjunction with screwed conduits, with waterproof lids, principally for use in new buildings and exposed positions where it is necessary to exclude moisture, water, or other deleterious matter. The lids are tongued to sink into the wall of the fitting, and firmly screwed and held in position by countersunk brass fixing screws passed through lugs cast on externally. In connection with the new patterns of junction boxes, &c., the company has introduced screwed brass and boxwood nipples, by the adoption of which a smooth duct is provided from the tube through the fitting, an advantage when drawing through wires after the erection of conduits. These specialities are detailed in the well laid out illustrated catalogue now before us. There is also a circular pattern junction box described, the tube outlet of which is entirely concealed behind the rim of the box.

**Import Duties on Trade Literature for the Australasian Colonies, India and Canada.**—The London Chamber of Commerce has for some time past been in communication with the representatives of the Commonwealth of Australia, the Government of India, and the Canadian Government relative to the levying of duty upon price lists and catalogues sent to Australasia, India and Canada. As a result of the representations made, the practices of the several Customs authorities have been defined, previous to which considerable ambiguity existed as to the levying of duty or otherwise. The Government of India in a recent communication, have stated that, "as they consider it desirable to afford all possible facilities for the development of trade, they have issued instructions that all trade catalogues and circulars imported into India by packet, book or parcel post, shall in future be admitted free of duty." In reference to Canada, the High Commissioner has informed the Chamber that "*bonâ fide* trade catalogues and price lists of goods for wholesale, not exceeding three to one person, are admitted into Canada without payment of customs duties. As regards Australasia, the Manufacturers' and Australasian Sections of the Chamber have also communicated with the Colonial Chambers of Commerce who have unanimously supported the representations of the London Chamber in favour of the free admission of trade catalogues into Australasia. It is to be regretted, however, that up to the present, the representations have not been favourably considered by the Commonwealth Government, it being officially stated that the primary object of the duty was not for the purpose of revenue, but for the encouragement of local printing, and that, therefore, the Commonwealth Government has no present intention of altering the law in this connection. Further efforts are being made with the object of obtaining a reconsideration of the matter by the Commonwealth Government, and it is suggested that the free importation of trade circulars and price lists will largely assist in promoting the trade of the empire.

**"L. & Y." Patent Electric Coupling.**—We have received from the Lancashire and Yorkshire Coupling Syndicate, of 7, Brazennose Street, Manchester, a sample of their mechanical coupling for electric light and power cables. The arrangement consists of a couple of sleeves, into the outer ends of which are serrated the ends of the cables to be joined. The other ends of the sleeves consist respectively of an accurately-fitting conical plug and socket; the latter are forced together by means of a couple of locking nuts, which screw into an external sleeve, and tighten up against two collars provided for that purpose on the cable sleeves. That the coupling offers a handy means of coupling up cables, which may require frequent disconnection, is self-evident; that it gives a better connection electrically than the soldered joint is not so self-evident, and will entail a certain amount of grinding in, if the conical socket and plug are to make any considerable contact. These couplings are made in various sizes, and appear to be cheap in first cost.

**Uralite.**—On Monday, August 29th, a demonstration was given by the British Uralite Co., Ltd., of the fire-resisting properties of their building material in Crown Street, Liverpool. It was witnessed by Chief Superintendent Thomas, of the City Fire Brigade, and members of his staff; also by many prominent architects and representatives of the local railway, dock and shipping companies, together with members of the Press. The test consisted of a wooden partition, platform and box, all covered with Uralite, and submitted to high temperatures. The box was subjected externally to a heat of 2,100°, while internally scarcely 100° was registered. The box contained various documents, which were handed round to the spectators in an absolutely undamaged condition after the fire had been extinguished.

**Patent Glazing.**—The Admiralty, who are now building a large new steam factory at H.M. Dockyard, Portsmouth, which will require some 102,000 ft. super of glass roofing, invited the principal glazing firms to tender for same, and we are informed that after a test of the various systems, the order is now being carried out with the "Superior" patent glazing by Messrs. Sam Deards, Ltd., of Harlow, and 34, Old Broad Street, E.C.

**Surgical Transformers.**—Mr. Louis M. Pignolet, of Cortlandt Street, New York, has sent us a list of his electrical transformers for heating cautery electrodes, of which he recently supplied three to the University College Hospital, London, making four outfits in all at that establishment.

**Dissolutions and Liquidations.**—A petition for winding-up the Motor Manufacturing Co., Ltd., is to be heard in London on October 25th. The petitioning creditor is Mr. H. Seddon, of Middlewich.

The Thunderbolt Patent Governor Co., Ltd., is winding-up voluntarily with Mr. G. B. Nancarrow (W. B. Peat & Co., Middlesbrough), as liquidator.

Notice appears in the *London Gazette* of the release of liquidator (Mr. G. S. Barnes) in the liquidation of H. M. Salmony & Co., Ltd.

Notice is given of a first and final dividend of 1s. 11½d. in the £ in *re* Fibra Covered Pulley Co., Ltd., of Euston Road, N.W.

**Trade Announcements.**—Messrs. Harry W. Cox, Ltd., of Cursitor Street, W.C., notify that on and after September 1st their business will be carried on at larger and more convenient premises at 1A, Rosebery Avenue, and 15-21, Laystall Street, E.C.

Messrs. Julius Sax & Co., Ltd., have appointed Mr. Wyllie Mellis, of 47, Oswald Street, Glasgow, as their sole agent for Scotland. He will carry a stock of regular lines.

**For Sale.**—The Mexborough U.D.C. is offering certain plant for sale in order to make room for larger units. Messrs. Wheatley Kirk, Price & Co. are offering the business of an electrical engineer at Muswell Hill for sale by tender. See our advertisement pages.

## LIGHTING AND POWER NOTES.

**Aix-la-Chapelle (Germany).**—A large scheme for electrical power transmission is proposed by the Ruhr Valley Damming Co., near Gemund, in the vicinity of Aix-la-Chapelle. It is proposed to establish turbine-equipped works for the utilisation of the available water-power, and supply Aix-la-Chapelle and a number of neighbouring towns and localities with electrical power. The order for the 5,000-volt generators has been given to the Lahmeyer Co., while the Siemens-Schuckert Works Co. has received the contracts for the generating station transformers and switchboards, and also for 16 out of 17 sub-stations' transformer plant. It is proposed to transform the primary generating current at 5,000 volts to 34,000 volts, and to transmit it by means of bare overhead copper conductors to the sub-stations, where it will be converted into low pressure and distributed by means of underground cables.

**Bo'ness.**—A start was made last week with the laying of the conduits and the cables in connection with the burgh electric lighting scheme. Steady progress is being made with the erection of the generating station, and the plant will be put down immediately. It is hoped that the light will be ready for the opening of the new Town Hall on 14th inst.

**Buncrana (Co. Donegal).**—A scheme is in hand for the public and private electric lighting of Buncrana. There is sufficient local water power available for the greater part of the year, and it is proposed to supplement two 50-H.P. water turbines by an engine in the summer time.

**Canary Islands.**—The balance-sheet of La Société d'Electricité de Las Palmas for the last financial year shows a loss of £3,446.

**Delvin (Ireland).**—At a meeting of the R.D.C., it was decided to reconsider the advisability of lighting the town by electricity, and in the meantime to obtain the opinion of a competent engineer on the matter.

**Dundee.**—A correspondent writing to the local papers on local power supply, calls attention to the availability of Loch Brandy and Loch Whorral for water-power. The former lake, some 70 acres in extent, gives an almost direct fall of 1,200 ft., and the latter is equally well placed.

**Llanwityd.**—A proposal is on foot to form a company with a capital of some £2,000 to undertake the electric lighting of Llanwityd Wells, and to employ electric traction for conveying visitors from the village to the wells.

**Leith.**—A large grain elevator and silo installation has just been completed at the Edinburgh Dock, Leith, the plant has a capacity of some 4,000 sacks per hour. The whole of the machinery is driven by electric motors, of which there are in use some 16 of 710 H.P.

**Littleborough.**—The U.D.C. has resolved to oppose the application of Mr. V. Fowler, of Warwick, for a prov. order for electric lighting, as the Council already possesses an order.

**London.**—Hampstead.—The last annual return of the Council's electrical undertaking, shows that the units sold amounted to 3,278,159, the equivalent 8-C.P. lamps connected to 212,306, the maximum load to 2,666 KW., as compared with 2,599,573 units, 179,817 8-C.P. lamps, 2,140 KW. maximum load, in the previous year. The income for the year amounted to £58,051, an increase of 22 per cent., and the net surplus, after meeting all expenses (including increased sinking fund payments) was £5,796, as against £4,441.

St. Pancras.—The Board of Guardians has decided to light the workhouse throughout with electricity.

**Plymouth.**—The accounts of the electric lighting undertaking for the past year show a gross revenue of £19,165. The total working expenses amounted to £9,990, and the balance carried to net revenue account, £9,175. Financial charges absorbed £5,980, and the balance of £3,195 was transferred to reserve. A total of 1,509,093 units were sold, the maximum demand being 1,017 KW.

**St. Helens, Lancs.**—The returns of the Electricity Department for the last year show that the total number of units sold amounted to 2,093,883, the gross revenue being £19,283, and the total expenditure £16,683 (inclusive of financial charges) leaving a profit balance of £2,600 for the year.

**Stockton-on-Tees.**—The returns of the electrical undertaking for the year ended March 31st, 1904, show a gross income of £5,432. Working expenditure amounted to £3,123, and the balance available for meeting financial charges to £2,309. As interest and sinking fund charges amounted to £3,278, a deficit of £969 results. The total output sold, amounted to 355,958 units.

**Stourbridge.**—The U.D.C. has been recommended by the Electric Power Committee to take such steps as may be necessary to proceed with the application to the Board of Trade for a provisional order under the Electric Lighting Acts which will comprise the parishes of Redmore, Hagley, and Clent only, the parish of Belbroughton not to be included in the application. At a recent meeting of the U.D.C. it was stated that the cost of obtaining the order would be approximately £300; and it was decided to delete the recommendation from the report.

**Swansea.**—The third year's accounts of the electricity department show a considerable advance on the previous year's results. The units sold amounted to 871,555, as compared with 578,182 in the previous year; 54,929 equivalent 8-C.P. lamps were connected, as compared with 42,112, and the maximum load was 625 KW., compared with 547 KW., a great improvement being observed in the load factor, which is practically 16 compared with 12 last year. The gross revenue amounted to £10,989, and the total working costs to £5,112, leaving a gross profit of £5,877. After meeting financial charges, a profit of £744 remained.

**Thanet.**—The Isle of Thanet Electric Tramways and Lighting Co., Ltd., has decided in place of the maximum demand system of 6d. and 3d. per unit, to charge a flat rate of 5d. per unit, with a discount of 5 per cent. for prompt payment of accounts, and an additional 10 per cent. discount on accounts above £10 per quarter.

**Tiverton.**—A L.G.B. inquiry has been held into an application of the T.C. for a loan of £13,000 for electric lighting purposes. Considerable opposition was offered by a local mercantile association.

**Wallasey.**—The annual report on the electricity undertaking shows that the gross revenue amounted to £20,579, and the total working expenditure to £8,548, leaving a gross profit of £12,031. Interest and sinking fund charges amounted to £4,857, and out of the balance £1,000 was placed to reserve, and £6,174 applied to the local rate. The total number of units sold amounted to 1,925,687, the maximum load, lighting, being 388 KW., and traction 450 KW.

**Whitehaven.**—The Harbour Commissioners have adopted a scheme of electric lighting for the harbour and docks. Current will be taken from the T.C. at a minimum payment of £350 a year.

**Wimbledon.**—The U.D.C. will, from October 1st, make the following charges to electrical consumers (including those responsible for religious and charitable institutions, &c.):—Private lighting, up to 400 units per quarter, 4½d. per unit; up to 800 units, 4d.; exceeding 800 units, 3½d. Street lighting, and lighting for municipal buildings, 2½d. Power, 2d. per unit; small motors, cooking apparatus, heaters, &c., requiring less than one ampere at 220 volts, lighting rates.

## TRAMWAY AND RAILWAY NOTES.

**Bewdley.**—The T.C. has unanimously decided to advise the Board of Trade against any extension of time being granted to the Kidderminster and District Electric Lighting and Traction Co. in constructing their proposed tramway between Kidderminster and Bewdley.

**Derby.**—Messrs. J. G. White & Co. have practically completed their contract with the Corporation. The Board of Trade are to make their official inspection almost immediately. Messrs. J. G. White & Co. on Monday last week entertained the members of the Tramways Committee, together with their wives, to luncheon at the Royal Hotel. The chair was occupied by Mr. Connett, a member of the firm. During the proceedings the contractors presented handsome silver flower vases to the Mayoress and Mrs. Duesbury, wife of the chairman of the Tramways Committee.

(*Continued on page* 383.)

# ELECTRIC HARBOUR CRANES.

In none of the uses to which electricity has been applied as a motive power has it proved more suitable than in its application to scattered and intermittently working machines, where the load is of a variable nature. This is particularly the case in crane work. The same reasons which render the electric motor especially adapted for driving overhead cranes apply with nearly equal force to harbour cranes. But whereas the introduction of electrical overhead cranes met with no obstacles, that of electrically driven harbour cranes was hindered by considerable difficulties.

Fig. 1.—View of Portal Cranes at Amsterdam.

In no country do we find such an extensive development of electrically driven harbour and wharf cranes as in Germany, and in the following article are described some of the recent examples of harbour cranes built by Messrs. Bechem & Keetman, Duisburger Maschinenbau Act.-Ges., at Duisburg (represented in Great Britain and Ireland by Mr. August Reichwald, Finsbury Pavement House, E. C.). This firm, in May, 1902, received an order from the "Koninklyke Nederlandsche Stoomboot Maatschappy," in Amsterdam, comprising :—

1. Eight "Portal" cranes, each of 2 ton carrying capacity, 10·5 m. projection from edge of quay, 22 m. lifting height (fig. 1).

2. Two "Portal" cranes, each of 6 tons carrying capacity, 10·5 m. projection from edge of quay, 22 m. lifting height (fig. 1).

3. One fixed revolving crane, of 30 tons carrying capacity, 9·9 m.

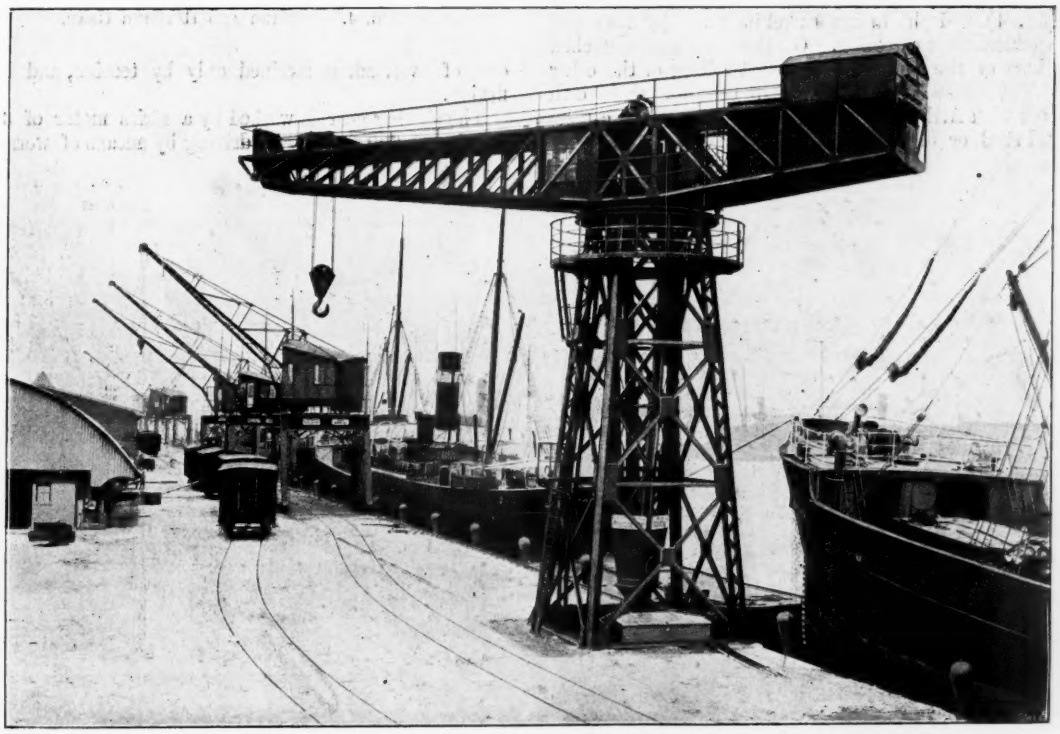


Fig. 2.—30-ton "Hammer" Crane

maximum and 2 m. minimum projection from edge of quay; 19·5 m. lifting height (fig. 2).

For working these cranes a direct current of 550-volts pressure has been employed.

After completing the erection of the cranes mentioned, the above-named firm received a further order for five cranes of type No. 1, which is now on the eve of completion by the same company. After this last order has been completed, there will be in all 15 cranes, ranging in capacity from 2 tons to 30 tons, at Amsterdam. Fig. 3 shows the row of cranes at present installed.

The jib of the crane is a stiffened truss composed of sectional iron and passing over into the iron structure of the

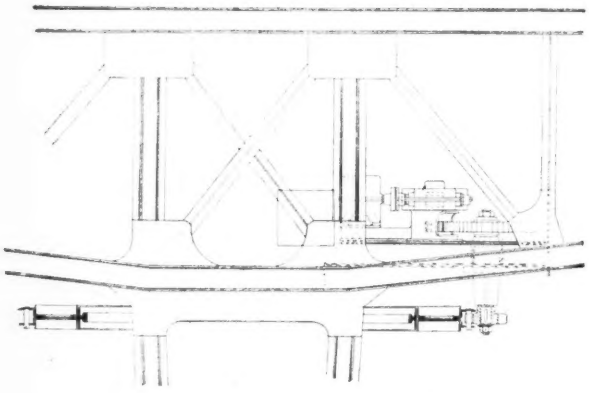


Fig. 5.—Arrangement of Rotating Gear.

cabin; the latter is mounted upon the platform of the crane in such a manner, that no stays whatever hinder the operator from attending to the controlling gear, or from seeing his work.

The upper platform consists of tubular girders, whereas the supports are made of channel and angle irons. Care is taken to provide sufficient cross-bracing. The slewing and hoisting gear is mounted upon a common cast-iron base-plate (fig. 4), and the lifting barrel is driven by means of double reduction spur gearing. Oil throwing rings attached to the boss of the large wheel prevent soiling of the other parts. The spur-wheels are all made of cast-steel, their teeth being cut with A.E.G. milling cutters. The pinions consist of forged steel, or of raw hide. The motor gear is placed

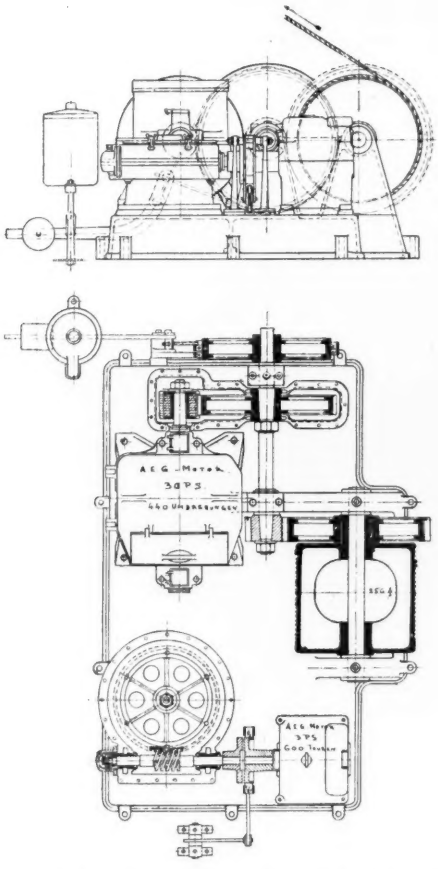


Fig. 4.—Slewing and Hoisting Gear.

in a cast-iron case, thus ensuring noiseless working. The load is held by means of an ordinary strap brake with double winding and wood-lining, and can be released by an electro-magnet. To make lowering possible also in case of sudden interruption of the current supply, a foot lever is attached, which is also capable of releasing the brake. The crane revolves upon four rollers of cast-steel, which run on circular rails. A centre-pin is employed for centring, being, in case of overloading, strained only by tension, and not by flexion.

The slewing gear is worked by a series motor of 3 H.P., running at 600 r.p.m., and driving by means of worm gear. The motor and worm-shaft are connected together by a movable flange coupling, which at the same time acts as a brake for fixing the crane, in order to prevent rotation such as might be caused by wind pressure. The current is supplied

Fig. 3.—View Showing Cranes at Present Installed at Amsterdam.

through the hollow centre-pin by two sliding contacts, which are so arranged that the operator is able to inspect and change the brushes without any difficulty.

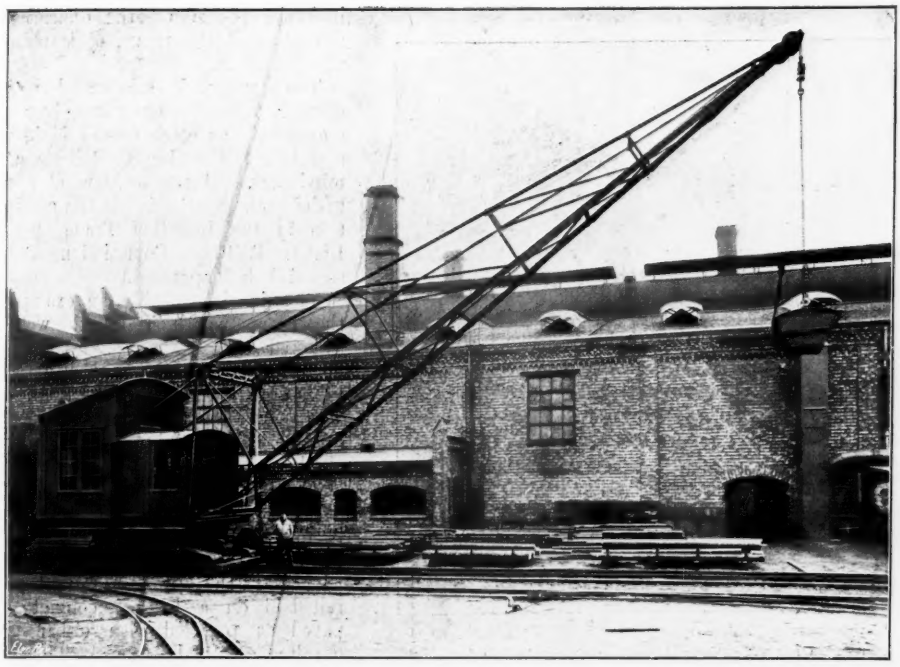


Fig. 6.—Shipyard Travelling Revolving Crane.

The crane is moved from place to place by hand, but provision is made also for electrical travelling. The crane is balanced by means of a counterweight, placed in the rotating part of the platform.

An altogether different type of crane is that of 30 tons capacity, shown in fig. 2, which is known as the "hammer crane," on account of its shape. The jib consists of two parts of unequal length, and revolves around a centre-post. Both jib and post are constructed as framework, and revolve within a square pyramid of strongly-braced corner pillars. The vertical and horizontal pressures are counteracted by suitable journal and pivot-bearings, the pressures on their surfaces, and consequently the wear and friction, being reduced to a minimum. To the upper extension of the centre post the sliding contacts of the main electrical conductors are attached.

The whole of the driving gear of the crane is placed on the jib and is operated from the driver's cabin, which is arranged in the last panel of the fore-jib, enabling the driver to watch the load and its position through the framework of the jib. The winding gear is placed on the back part of the jib. Travelling of the load within the required limits is effected by means of two calibrated chains, which by means of two balance levers equalising the pressure, are attached to the crab and run over two toothed chain pulleys, the latter being driven by an electric motor of 14 H.P. The arrangement of the rotating gear is shown in fig. 5. A block brake is provided for fixing the position of the jib.

While the cranes installed at Amsterdam are exclusively used for handling goods in packages, the travelling revolving crane described below is chiefly destined for loading and discharging goods in bulk from ships into trucks, and *vice versâ*. This crane has a capacity of $4\frac{1}{2}$ tons and a radius of $12\frac{1}{2}$ metres.

The working speeds are as follows :—

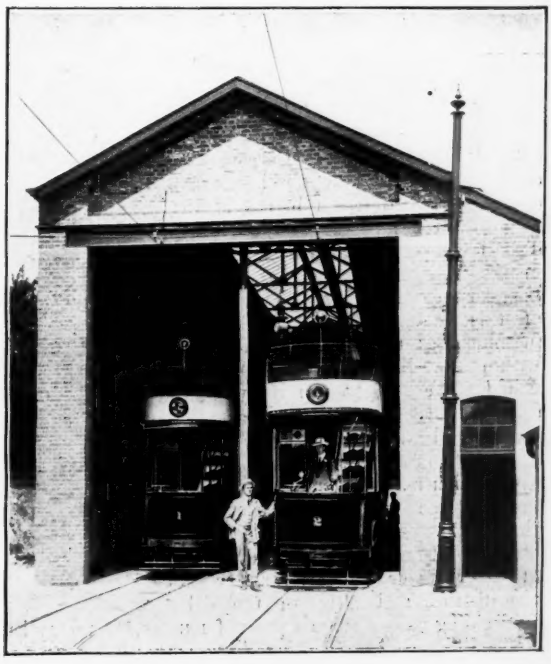
| | | |
|---|---|---|
| Lifting of load ... | ... 35 | metres per minute. |
| Revolving ... | ... $1\frac{1}{2}$ | „ „ |
| Travel of crane ... | ... 30 | „ „ |

Direct current at 440 volts is taken from the town mains of Duisburg. The arrangement of the upper revolving part and of the jib, differs but little from that of the crane at Amsterdam.

We learn that experiments performed with this crane by Messrs. Bechem and Keetman (Duisburger Maschinenbau Act.-Ges.), Duisburg, as to its efficiency and consumption of energy, proved that it was capable of loading 1,240 tons of ore from ships into railway wagons within $9\frac{1}{4}$ hours, with a consumption of energy of 115 KW.-hours. The crane also moved the loaded trucks, the driver of the crane having had no assistance whatever.

As a last example, a travelling revolving crane supplied for the shipyard of Messrs. Blohm and Voss, in Hamburg, may be mentioned. This crane is shown in fig. 6. Its principal deviation from the previous ones consists in the variable radius. It is used for handling iron and transporting goods in packages and bulk. Its carrying capacity is :—

At a radius of 17 metres, 1 ton 4 cwts.
„ „ 16 metres, 1 ton 10 cwts.
„ „ 12 metres, 3 tons.



Maidstone Light Railways: View of Car-shed.

An electric motor of 12 H.P. adjusts the radius by means of two screw spindles of Siemens-Martin steel, the nuts of which are fixed on the jib. The employment of spindles

instead of the commonly used chains has the advantages that there is always a rigid connection between base-plate and jib, and that oscillations of the latter, which might be caused by shocks, especially when setting down the load, are thus avoided. The other details of construction differ but slightly from those of the crane previously described.

High Street Terminus, Maidstone: View showing Queen's Statue.

Direct current at 110 to 120 volts is led to the motor along the crane track. The flexible cable is wound up automatically during the travelling of the crane upon a cable drum placed on the carriage of the crane.

This crane, we are informed, has proved very satisfactory on trial.

## MAIDSTONE CORPORATION LIGHT RAILWAYS.

On July 14th the Corporation's recently constructed light railways were opened for public traffic by the Mayor, who drove the first car over the route. The line extends from the Town Hall in the High Street to the borough boundary at Barming. The history of this venture is rather remarkable, inasmuch as the undertaking, wholly within the borough, was sanctioned under the light railway procedure, thus upsetting the views generally held regarding the Taunton decision of the Light Railway Commissioners.

For some considerable time past the Maidstone Corporation had been desirous of carrying out a system of tramways or light railways within the district, and although the delay in deciding upon a scheme was unfortunate, the promptitude with which the Corporation has constructed the present line is much to be commended, inasmuch as the order was only confirmed in December last. The original delay has probably been of advantage, for the reason that the light railway scheme now working has, through it, received greater care and consideration both towards obtaining a satisfactory undertaking, and one that bids fare to be a financial success.

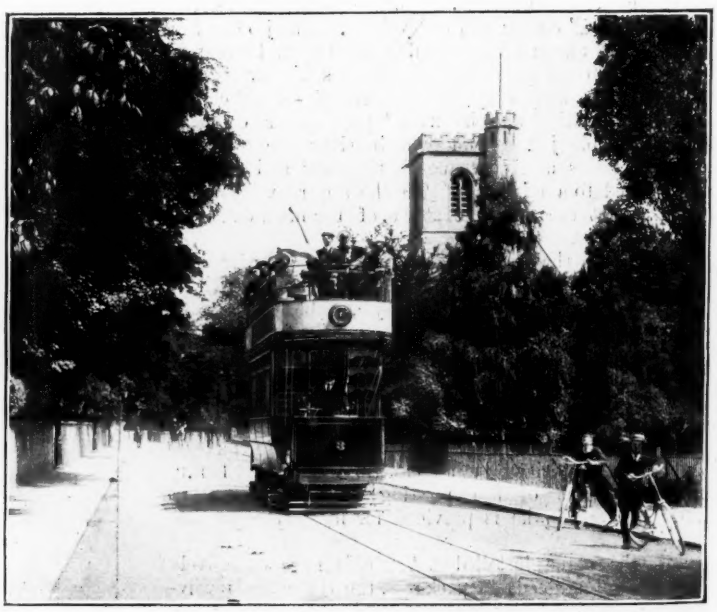
As early as 1900 Mr. Stephen Sellon was called in by the Corporation to advise, and in due time the present scheme was finally determined upon; the Corporation, in its initial endeavour, has been prudent in not going to a large capital expenditure until it sees how the people of the district take advantage of the means of transit now afforded them.

The proposed scheme has been strongly opposed at every stage by certain sections of the ratepayers of Maidstone, and before the Light Railway Commissioners. Attempts were also made to defeat the application at the confirmation by the Board of Trade after the Light Railway Commissioners had signified their approval.

The line is, probably, an example of the economy which might well be followed both by companies and corporations contemplating the construction of tramways or light railways. The length of the line is about two miles, and the total cost, including the overhead equipment, six cars, car-shed, and all necessary appliances, cables, switchboards, &c., will not, it is anticipated, exceed the sum of £20,000.

The system of track construction adopted is the ordinary grooved girder rail laid on a bed of concrete and paved as required with either wood, granite, or local stone. The overhead work is span wire construction and on the under-running system, the poles throughout the whole of the route being used for the purposes of street lighting. The power for the undertaking is supplied from the Corporation Electricity Works, which has undergone some few necessary alterations at the hands of Mr. Hoadley, the borough electrical engineer.

The whole of the work was executed by Messrs. Dick, Kerr & Co., and has been carried out in accordance with their usual high standard.



View on Route, Maidstone.

The track has been laid to a 3 ft. 6 in. gauge, with points in accordance with the latest practice, 13 ft. long over-all, of the extended leg type; the tongues which are 8 ft. 6 in. in length are specially spiralized in order to give the cars easy entrance to the loops. The rails used are the British standard No. 2 section, weighing 95 lbs. per yard; the joints are of the "Dicker" type. Tie-bars are spaced at

6 ft. intervals, and the track has been bonded throughout with 4/0 Neptune bonds.

The cars are of the double-deck, single-truck type, and are similar to those supplied to the Leicester Corporation, for Messrs. Dick, Kerr & Co., by the Electric Railway and Tramways Carriage Works, Ltd., Preston, who were the builders in this case also.

Each car has a seating capacity of 48 persons, 22 inside, and 26 outside. The electrical equipment consists of Dick, Kerr's standard 25 B type, 500-volt motors (approximately 28 H.P.), mounted on Brill 21 E trucks. The controllers supplied with the electrical equipments, are Dick, Kerr's standard D.B.I. form "C" type, arranged for rheostatic braking.

The car-shed has been constructed with a view to economical extension; the east wall, on which side the extension will probably be made, being panelled with 9 in. brickwork between steel stanchions carrying the roof principals. The main shed proper contains pit accommodation for four cars, and provision has been made for offices, stores, paint, and repairing shops, &c.

We hear that excellent results have been obtained in the way of traffic receipts since the opening, on many occasions every car being required to carry the traffic over a route which has hitherto been devoid of any means of communication in the way of public conveyances, and although the tramway serves one of the least populated districts of Maidstone, it has carried a number of passengers equalling the whole population of that town 1½ times during the course of a week. It is, therefore, anticipated that a very satisfactory profit will be shown at the end of the first year's working.

We wish the Maidstone Corporation every success in its venture.

## TRAMWAY AND RAILWAY NOTES.

(*Continued from page* 378.)

**Bradford.**—An article appeared in the *Bradford Daily Argus* for August 17th, in which the Corporation tramway accounts are attacked by a writer, who finds fault—and very justly as it appears from the facts and figures there given—with the irregularity of the department in dealing with the question of depreciation. It seems that for the year ending March, 1904, only £2,916 is set apart for depreciation, while the capital account stands at £800,000. Two years ago, however, when different ideas seem to have been held, the allowance was between three and four times as great, being £10,015, in spite of the fact that the capital account was only one-half what it is now. The alleged profit of £13,399 for the past year, it is contended, would really be turned into a big loss if sound financial methods controlled the policy of the department. As compared with 1902, the depreciation allowance for 1904 should have been £20,000 instead of £2,916. The attitude of the chairman is said to be this, that if renewals are paid for out of revenue there is no necessity for providing for depreciation. That this is altogether wrong is, of course, plain to our readers, for as the writer says, on this theory a periodically repaired tramcar will be as good in 30 years' time as it is to-day. It is said that the small balance of £2916 is labelled "Depreciation," as a sort of apology for the absence of the item in the revenue account, but if there is *no necessity* for allowing depreciation, why allow even the £2,916 to stand as such? It would be more consistent to allow nothing and allocate the sum to reserve fund. It is a weak line to adopt, and certainly appears to be a bit of municipal profit-showing of the kind to which we are now well accustomed.

**Falkirk.**—The company which, in 1901, obtained the prov. order to construct and run the tramways recently completed arrangements for selling their rights to an Edinburgh syndicate; but it now appears, says a correspondent, that a member of the original company has challenged the transaction which he asserts is *ultra vires*. He also threatens to apply for interdict if any attempt be made to carry out the scheme.

**Great Northern and Brompton Railway.**—The Great Northern, Piccadilly and Brompton Railway Co. is carrying out work which affects the business of Mr. John Murray, in Dover Street and Albemarle Street. The question of compensation went to arbitration before Mr. Ralph Clutton early in the year, and he has now published his award at £18,110. The amount claimed was near £30,000, while the company offered about £13,000.

**Heckmondwike.**—Our Dewsbury correspondent writes:—"In consequence of the disagreement between the Heckmondwike U.D.C. and the B.E.T. Co. as to the price to be paid by the company to the Council for current, the tram service in the town has been curtailed. This has caused great inconvenience to the travelling public. The service to Hightown and the Batley boundary has been suspended. The cars from these places now stop outside the Heckmondwike boundary, and passengers have either to walk to the centre of the town, or travel by other cars. Some of the stages have also been interfered with, and to reach certain points which formerly constituted a direct penny stage, it is now necessary not only to change cars, but to pay for two penny stages. The District Council has offered to accept a smaller payment than is stipulated in the agreement, but the company urge that the amount, which is based on the maximum demand, would still be unreasonably high for the aggregate consumption. The area supplied by the Heckmondwike Council is very small, and the maximum demand is said to be considerably heavier than the company's engineer anticipated it would be. Negotiations between the Council and the company were broken off a few weeks ago, but it is now stated that there is a likelihood of a conference being held at an early date with a view to arriving at a settlement."

**Light Railways.**—The Board of Trade have recently confirmed the undermentioned orders:—(1) Cheltenham and District Light Railway (Extension No. 3) Order, 1904, authorising the construction of an additional light railway in the county of Gloucester in the borough of Cheltenham, and the abandonment of the construction of part of another light railway already authorized in the same borough; (2) Maidstone and Faversham Junction Light Railway (Extension of Time) Order, 1904.

**Metropolitan District Railway.**—Last Saturday night the District Railway Co. closed a certain part of its line—the Earl's Court section—until the following Monday in order that greater progress might be made with the electrification.

**Middlesex.**—The Metropolitan Electric Tramways Co., on 24th ult., opened another section of tramways, carrying the system to the Tottenham boundary.

**Paris.**—A section of electric tramways at Charenton was stopped for some hours on 24th ult. through the theft of cable during the night from the Bois de Vincennes.

**Salford.**—The annual report of the general manager of the Corporation tramways and statement of accounts for the year ended March 31st, 1904, have just been issued. It appears that the total length of tramways now worked by the Corporation is 59½ miles (single track). The stock of cars on March 31st, was 150, of which 100 are of the double-decked single-truck type, and 50 double-decked bogie cars, all the cars having staircases of the reversed type. Several experiments having been successfully tried during the year with outer deck coverings fitted to the cars, it was decided to equip 20 of the single-truck cars with covers of an approved type. The traffic returns show largely increased receipts in the gross, although a decrease in the earnings per car-mile has resulted, due to the unfavourable weather which prevailed during the greater portion of the year. The number of passengers for the year was 36,956,405, an increase of 8,805,730, as compared with the preceding year. The receipts were £53,936 more last year than in the previous year—£198,422, against £144,486. The year's working resulted in a gross profit of £60,106, to which must be added the sum of £242 for interest on investments, making a total available balance of £60,348, and this was dealt with as follows:—Payment to local authorities for running powers, &c., £10,903; interest and sinking fund charges, £34,005; contribution in relief of rates, £12,000; reserve and renewals fund, £3,440. The amount now standing to the credit of the reserve and renewals fund is £12,202.

**Wirral Railway.**—At the half-yearly meeting of the Wirral Railway Co. on Monday, the chairman said the directors had not lost sight of the possibility of electric development; but they were waiting until greater proof of its perfect efficiency was given.

## TELEGRAPH AND TELEPHONE NOTES.

**New Telephone Plant at Salt Lake City.**—In *Sound Waves* a most interesting catalogue is given of the work done on a new telephone plant for Salt Lake City, Utah. The system is a complete common battery system, the main exchange having an ultimate capacity of 12,600 lines and a present capacity of 6,400. The distribution is partly by underground cable and partly by aerial cable. The use of aerial cable for telephone distribution is increasing very largely both in America and in this country. In the underground plant there have been built 256,963 ft. of single duct, the total length of conduit being a little under five miles. The work of conduit building was begun in August, 1903, and finished in February of this year. The total cost was nearly £11,000, or about 10½d. per duct-foot of completed conduit, including manholes and laterals. The total length of cable installed is about 24 miles, containing 8,524 miles of conductor. Five sizes of cable are used, ranging from 50 to 200 pair. The cable was drawn in at the average rate of 7,118 ft. per day. The greatest amount drawn in in one day was 14,919 ft. This length of cable was placed in the ducts in eight hours by a gang of nine men. The overhead plant consists of 4,325 poles with about 60 miles of aerial cable. The sizes of cable used range from 25 to 100 pairs. The total length of conductor is 7,216 miles. For leading-in purposes 53 miles of twisted pair rubber-covered wire were used. The average amount of aerial cable strung per working day was 4,400 ft. The central office building is 50 × 118 ft. Work on it was begun July 1st, 1903. The building was completed January 1st, 1904, and occupied the following May. The approximate cost of the building was £17,000. The approximate cost of the main switchboard, for a present capacity

of 6,400 lines, was £20,000. The present length of the board is 120 ft. It contains 10,800 ft. of 42-pair cable, 200 ft. of 21-pair cable, 5,780 ½-C.P. lamps, 165 pilot lamps, 5,400 answering jacks, 60,000 multiple jacks, and 1,350 plugs and cords. The exchange is equipped with a chief operator's desk, and with a toll-board for suburban connections having a capacity of 100 toll lines and 100 junctions. The dimensions of the operating room are 90 × 45 ft., the height of the ceiling being 25 ft. The power plant consists of two duplicate charging sets, each consisting of a 20-H.P. alternating current motor coupled direct to a multipolar generator with an output of 12 KW., giving 200 amperes at 60 volts. The ringing dynamotors, equipped for machine ringing, busy-back signals, &c., are also in duplicate. Two sets of storage battery cells are provided, each consisting of 20 cells, having an ultimate capacity to operate an exchange of 12,600 lines for 24 hours without re-charging. The exchange also contains a wire chief's desk equipped for testing, an information clerk's desk, a fault clerk's desk, and a monitor's desk. The formidable list of apparatus contained in this exchange gives some idea of the magnitude and complication of a modern telephone plant.

**Submarine Telegraphy.**—"Die Unterseekabel in Wort und Bild" (submarine cables described and illustrated) by Mr. O. Moll, formerly of the Direct United States Cable Co., but now manager of the German Atlantic Cable Co., is reviewed in the *Journal Télégraphique*, August 25th, 1904. The book, it is said, has numerous illustrations, and has been issued with the object of instructing and interesting young people in Germany in the manufacture and laying of submarine cables as a means for augmenting the prosperity of the nation. The book deals in detail with the manufacture of cables, the building and use of cable-ships and their duties. A complete history of submarine telegraphy from the day of its inauguration to the present day is also given, accompanied by a description of the German Trans-Atlantic cables, and particulars of the School of Telegraphy at Emden. The economic and political aspects of cables, and the necessity of further effort in this direction by the German nation to assure the prosperity of their commerce and naval efficiency are separately dealt with.

**The Study of Telephone Traffic.**—In an article on "The Relation of Telephone Traffic to Efficient Service," Mr. H. S. Knowlton, in the *Electrical World*, gives some most useful information on the study and testing of telephone traffic by modern methods. The writer's ideas are summed up in the following paragraph:—

"Perhaps no branch of electrical work offers greater opportunity for profitable traffic study than telephony. This is because of the enormous amount of detail which invests the business. The efficiency of the service is a direct function of the way the traffic is handled, and, within certain limits, it depends more upon the personal equation of the operating force than upon the equipment. Good operators can give better service with that which does not represent the latest design than poor operators can give with the most modern appliances."

The author goes on to describe the methods of studying traffic by making accurate counts of the day's work in a telephone exchange, and of testing the efficiency of the operating by systematic timing observations. He lays much stress on the importance of "team work," that is, of training operators to help each other, instead of each confining her attention strictly to the signals at her position. The methods of counting telephone traffic, and of testing the service, are described in detail, and the author sums up the general principles of the management of telephone operating as follows:—"The question of operators' loads is important, and always bears investigation. Theoretically, the limit of an operator's capacity to handle calls is determined by the average number of seconds which she has to give to each call, supposing team work to be effective also. In a case which came to the writer's attention, this average was 7½ seconds during the busy hour, and the corresponding average maximum number of calls handled by the operator was nearly 360 per hour. This applies, of course, to local operators, and not to trunk or incoming junction positions. Even in times of heavy traffic it is improbable that all the operators of a group will be busy simultaneously, so that if team work is properly developed there will almost always be an operator within reach of a call to answer it promptly, if the operators are sufficiently trained to answer every call within reach, regardless of whether the call originates in front or at the side. There are thus five operators within extreme reach of a call, on most large switchboards, and if all these fail to answer it, there is still the chance that the supervising operator will transfer it to some less busy section of the board, in time to avoid serious delay. Where good team work exists, there should only be that decrease in the speed of operators' answering calls with increasing loads due to the slightly greater time required for operators to answer in the multiple or to plug into the answering jacks of adjacent positions. The operators should be so trained that there will be no delays in the service through an operator being obliged to attend to a second call before completing the first. All classes of service are maintained at a high standard of efficiency by good team work. If an operator knows that a call originating in front of her will be handled by an adjacent operator if she is unable to answer it herself, she is in a position to give her undivided attention to each call.

"The highest efficiency in handling traffic is secured when the service from all sections of the switchboard is as nearly the same as possible. To this end, therefore, all subscribers should be obliged to give the numbers which they require, rather than names; operators must not be allowed to gossip with subscribers or each other, and the fewest possible words should be aimed at. Discipline in the operating room is a matter of great importance. Lack of punctuality in taking positions at the switchboard, turning away from the board to look at visitors, snapping keys and pulling down connections by grasping the cords instead of the plug handles, are some of the factors which are harmful to the service. Operators should never enter into disputes with subscribers; if subscribers persist in talking the proper course is to switch them to the chief operator or manager's desk."

## Telegraphic Interruptions and Repairs:—

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Trinidad-Demerara, No. 1 | Aug. 26, 1901 | |
| Dominica-Martinique | May 7, 1902 | |
| St. Lucia-Martinique | May 7, 1902 | |
| Cayenne-Pinheiro | Aug. 13, 1902 | |
| Reissa-Issa (Yemen)-Camaran | Oct. 22, 1902 | |
| Tarifa-Tangier | Jan. 18, 1904 | |
| Paramaribo-Cayenne | July 13, 1904 | |
| Closed { Vladivostock-Nagasaki | Feb. 9, 1904 | |
| Closed { Port Arthur-Chefu | Mar. 9, 1304 | |
| Cape Haitien-Mole St. Nicholas | Aug. 20, 1904 | |
| Bundaberg-Gomen (New Caledonia) | Aug. 30, 1904 | |
| **Landlines.** | | |
| Seoul-Masampo | Feb. 18, 1904 | |
| Seoul-Gensan | Feb. 18, 1904 | |
| Anju-Ping-Yang | Feb. 25, 1904 | |
| Ninguta-Vladivostock | March 2, 1904 | |
| Moulmein-Bangkok | July 13, 1904 | Aug. 13 |
| Caimanera-Santiago | June 15, 1904 | |
| Puerto Gallegos-Punta Arenas | Aug. 18, 1904 | Aug. 27 |
| Fao Route | Aug. 25, 1904 | Aug. 27 |
| Rome-Constantinople | Aug. 27, 1904 | Aug. 27 |
| Cartagena-Baranquilla | Dec. 8, 1900 | |
| Puerto Bairros | July 28, 1902 | |

**The Paris Telephone Service.**—The second number of the bulletin of the Paris Association of Telephone Subscribers is, as might be expected, hardly so interesting as the first. A large part of this issue is given up to the recital by subscribers of their struggles with the administration to get a good service. There is much wailing over bells that do not ring, operators that do not operate, inspectors that do not inspect, and superintendents who write explanations that do not explain. An article of some interest gives a detailed account of the proposed addition to the telephone staff in Paris, for which the Chamber of Deputies is asked to vote a yearly sum of 242,675 fr. for 270 new operators. It would appear that the staff must have been allowed to run rather behind the work if 270 operators are needed at once. The total number of subscribers in the Paris system is not stated, but the number of operators' positions at the different exchanges is given in detail, the total being 650. At an average of 60 lines per position this would mean about 39,000 subscribers' lines. For the regular work of the subscribers' boards 1,300 operators are required, and for the long-distance boards 208. In order to allow for sick leave, &c., 10 per cent. more operators are required, and for supervision and monitor work 312 supervisors and monitors. This gives a total of 1,971 trained operators. As the operators have to be trained before they can be put at the switchboards, a certain proportion of operators are always under instruction. This adds another 150 to the staff, and to cope with the normal increase of subscribers 50 new operators are needed each year. This brings the total number of operators required at present to 2,171. From a further paragraph in this article it appears that the total number of interurban circuits in France is 5,291, there having been an increase of 1,817 circuits during the year 1903. The total number of telephone subscribers in France, outside of Paris, is 54,509, there having been an increase for the year of 9,500.

In an article by one of the legal members of the Association a detailed review is made of some of the Government regulations affecting the telephone service. The legal authority finds fault with many of the regulations, and condemns them as arbitrary and unpractical. He finds fault in particular with one rule, which lays down that in all towns of over 80,000 inhabitants the telephone service shall be supplied only at flat rates. The reviewer very justly remarks that this bars out the small user and prevents many people from using the telephone service at all.

**Telegraphic Communication between Argentina and Chili.**—*The Journal Télégraphique* of August 25th, 1904, states that the Governments of the Argentine Republic and Chili have concluded an agreement, the text of which is quoted *in extenso*, for the purpose of facilitating telegraphic communication between these two States. With this end in view, the landlines will be extended by each Government until a junction is effected at Uspalata, and at other points to be fixed by mutual agreement. The agreement fixes the inter-State charges and regulations for working by circuitous routes in the event of interruption to the wires of either Government whose telegrams are sent free of charge, and enjoy priority over all other telegrams. The Chilian telegraph administration are to enter upon negotiations for an agreement between themselves and telegraphic enterprises landing on their shores for the purpose of securing to the Argentine, Uruguay, Bolivia, Paraguay, and Brazil the same advantages as are enjoyed by themselves. On the other hand, the Argentine Republic will make similar demands upon the Governments of Brazil, Uruguay, Paraguay, and Bolivia to secure to Chili and Peru the same advantages as they have obtained for their country.

**Telegraph Cable Imports.**—There was rather a large importation of foreign telegraph cables and apparatus connected therewith, into this country during July, a total of £3,946 being reached. So far as the year has gone, however, these imports show a decline, the returns for the first seven months of the year showing an aggregate of only £20,431 as contrasted with £33,731 in the corresponding period of last year.

**Telephone Etiquette.**—A paragraph in a recent issue of the *American Telephone Journal*, says that "doubtless there is not a business man in the city who has not had occasion many times to call the attention of some of his clerks to the fact that each person who rings up on the office telephone is not a personal enemy. The ordinary office clerk who responds to a telephone call takes on a tone of voice as though he were answering under protest. He is surly, sharp and disagreeable—at least that's the way it sounds. It is to overcome this difficulty that a little card, attractively printed and without an advertisement on it, is now being hung close by the telephone in many offices. It tells how a telephone call should be responded to, thus:—

"When using this telephone remember that a stranger is at the other end of the line.

"Remember that the tone of your voice may make him a customer or drive him away.

"Make a customer of him, and you increase your usefulness to this office.

"Therefore, when using this telephone, always be polite, agreeable, accommodating and patient.

"Act, when you answer a call, as though it were the only bit of work you are called upon to do all day, and do it in an absolutely perfect manner."

Users of the telephone service in this country probably have had many experiences which confirm the remarks of our American contemporary. The phraseology of the notice might be improved on, but the circulation of a similar card among telephone subscribers here, would probably materially help the general efficiency and convenience of the telephone service. Telephone subscribers and their employés are by no means free from all responsibility in respect to the usefulness of the service to each other.

**Wireless Telegraphy.**—In connection with the leader on this subject in our last issue, we learn that the German Government has sent out an invitation to the various countries interested to send representatives to an international conference on wireless telegraphy, to be held in Berlin on October 14th next.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Aberdeen.** — September 27th. Twenty top-deck car covers for the Tramways Committee. See "Official Notices" to-day.

**Barking Town.**—September 20th. Rails, permanent way, overhead equipment, and feeder cables, for light railways extensions. See "Official Notices" August 26th.

**Edmonton.**—September 27th. The U.D.C. invites offers from companies willing to carry out its electric lighting provisional order. See "Official Notices" August 26th.

**Holland.**—September 22nd. The municipal authorities of the Hague, Holland, are inviting tenders, until September 22nd, for the supply of 8,000 to 9,000 tons of steel rails for electric tramways.

**Johannesburg.** — September 12th. 300 Alternate current and 300 direct current meters, also 600 fuse boxes for the T.C. See "Official Notices" to-day.

**Leeds.**—September 12th. Wiring installation, also subway and underground concentric mains for lighting new hospital blocks and workhouse. See "Official Notices" to-day.

**Leyton.**—September 23rd. Electric wiring and fittings for Newport Road School. See "Official Notices" to-day.

**London.**—October 4th. Three electric car traversers for the L.C.C. See "Official Notices" August 5th.

**London.**—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

**Rochdale.** — Wiring of car depôt. See "Official Notices" to-day.

**Spain.**—September 3rd. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until September 3rd for the supply of 70 tons of galvanised iron telegraph wire, 4 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

**Swansea.** — September 7th. Two negative tramway boosters for the Corporation. See "Official Notices" August 26th.

**Wallasey.**—September 14th. High tension switchgear for the U.D.C. See "Official Notices" to-day.

**West Ham.**—September 13th. Tramway poles, fittings, wires and fittings for the Council. See "Official Notices" August 26th.

**Wrexham.**—September 7th. Cable, boxes, troughing, and converting gas to electric fittings, for the Corporation. See "Official Notices" to-day.

### CLOSED.

**Dover.**—The T.C. has accepted the tender of Messrs. C. A. Parsons & Co., for condensing plant at the Electric Light Works, at £1,450.

**Fulham.**—The B.C. has accepted the tender of Messrs. Windsor & Co., of Fulham, for the extension of the Electric Light Works, at £539.

**Newport (Mon.).**—Messrs. A. G. Arnold & Son, of Newport, have received the contract for the installation of electric light at St. Mark's Church.

**Walthamstow.**—The U.D.C. has accepted the tender of W. T. Henley's Telegraph Works Co., Ltd., for supplying cables during the ensuing two years, also the tender of Messrs. Oliver and Co. for supplying and fixing 132 arc lamps with double carbons.

**Wimbledon.**—The U.D.C. has accepted the tender, at £5,069, of Messrs. Babcock & Wilcox for boilers in connection with the electric light extensions.

## NOTES.

**South African Notes** (from our Durban correspondent). —*Delagoa Bay.*—In reference to the development of Delagoa Bay, it has been decided to order four more cranes, of a capacity of five tons each. These will be of the same type as the heavier cranes now in use of the swinging arm pattern, and will be worked by electrical power. These are intended to supplement the Temperley transporters, which will, it is hoped, have enough to do in connection with the goods intended for the sheds. In the transit trade a vast quantity of merchandise will be loaded straight on to railway trucks, and it is for this class of consignments that the new cranes are principally required. The cost is about £2,500 each, and delivery will probably be given in about nine months.

*East London* (*Cape Colony*).—The contract for the two miles extension of the Municipal tramways has been signed by the contractors, Messrs. Strong & Moore, and the work will be put in hand at once. These extensions are along the sea front, and in Oxford Street.

*Cape Town* (*Cape Colony*).—At a Town Council meeting on July 28th, a resolution was passed, "that no licences will be granted next year to trams of the company, unless all trams are fitted with life fenders."

*Durban* (*Natal*).—The Municipal Tramways yearly return to July 31st, 1904, states that the revenue from traffic receipts amounted to £86,275—a decrease of £6,714, compared with the revenue during the preceding year. The revenue for the year now closed was estimated at £79,567, which has been exceeded by £7,000.

Revenue Statistics.

| For year ending July 31st— | 1903. | 1904. |
|---|---|---|
| Traffic .. .. .. .. .. .. .. | £93,192 | £86,274 |
| Other .. .. .. .. .. .. .. | 220 | 561 |
| Total .. .. | £93,412 | £86,835 |
| Car-mileage .. .. .. .. .. .. | 1,039,186 | 1,032,350 |
| Passengers carried .. .. .. .. | 9,208,332 | 11,501,000 |
| Passengers carried per car-mile .. .. | 8·86 | 11·14 |
| Average fare per passenger .. .. .. | 2·42d. | 1·77d. |
| Traffic receipts per car-mile .. .. .. | 20·41d. | 20·109d. |
| Traffic receipts per mile of route .. .. | £8,472 | £7,863 |
| Average fare charged per mile .. .. .. | 2·18d. | 1·09d. |

*The Johannesburg Unemployed.*—The following cutting may not be interesting as electrical news, but it shows the state of affairs in Johannesburg. Those who come out without berths would most probably, for a time at least, merely swell the ranks of the unemployed. "Johannesburg, August 3rd (Special).—Some 500 applications for work have been received at the Town Engineer's Department. To-day the position is one of serious concern. Many able-bodied men are tramping the streets in the vain hope of finding means to earn a livelihood. Government has been approached."

Another correspondent writes:—

*Lourenço Marques.*—Mr. Askew, manager of the local electric light works, has returned to town on completion of his five months' holiday in Europe.

*Johannesburg.*—At a meeting of the T.C., the following recommendation of the Tramway and Lighting Committee was agreed to:—"That a capital expenditure of £13,500 be sanctioned for the erection of a three-story building on the generating station site, to comprise, in addition to the office accommodation required for the Tramway and Lighting Department, rooms on the ground floor suitable for letting." It transpired that the amount of £1,200 per annum would be collected for rent. It was further agreed that a capital expenditure of £3,250 be sanctioned for the erection of married quarters for four foremen on the generating station site.

*Durban.*—The telephone manager, Mr. W. Manson, reports that the following progress has been made with the installation of the new telephone system:—Four routes have been erected for overhead wires outside the town, viz., in Umbilo, Masgrave, Florida, and Ridge Roads; 50,000 ft. of ducts have been laid, and 18 manholes built; 500 base boards, with arresters complete, have been fitted in subscribers' offices, ready for fixing the new telephones to be used in connection with the new system. The new exchange building, however, can hardly be completed before the end of the year, or in the early part of 1905, at the present rate of progress, and until the building is nearing completion, we are precluded from proceeding with the internal equipment.

**The Price of Carbide Abroad.**—An important firm of merchants in Germany is now offering to supply large calcium carbide, of a quality fulfilling the requirements of the German Acetylen Verein, at local prices varying from 21·40 to 22·20 marks per 100 kilos according to the situation of the depôt (of which there are six in different towns) where it is sold. These prices are for the net weight of carbide mentioned, drums free; but an allowance of 2 marks is made for every 100 kilo drum returned in good condition to the original factory, provided a new order is simultaneously given for as much more carbide as the empty drums represent. The prices are also net cash. At the present rate of exchange (20·45) these prices are equivalent to from £11 14s. to £12 2s. per long ton without allowance for returned drums, or from £10 12s. to £11 with allowance. Small carbide, in pieces 5 to 15 mm. in size, of good commercial quality, but not guaranteed like the previous material, is 2 marks per 100 kilos more. The offer is to last until the end of next March. These figures show how the price of calcium carbide has fallen in Germany since the last makers' syndicate was wound up. In France the local rates for 10 ton lots of calcium carbide in 100 kilo drums, gross for net, drums free, range from 34 to 39·8 fr. per 100 kilos according to the locality of the town having a depôt (of which there are 52 scattered over the country). At the present exchange rate (25·27) this is equal to from £15 to £17 12s. per long ton, but the drum is charged for as if it were carbide. Small carbide, smaller lots, and lots packed in smaller drums, are charged at a higher rate. In most parts of the United States large carbide is quoted at $70.00 per short ton, the price rising to $85.00 or $100.00 in a few districts a long way from the factories.

**Jubilee Celebration of the Society of Engineers.**—This is the jubilee year of the Society of Engineers, and the Council have decided that this epoch in the Society's history shall be celebrated by a conversazione. Arrangements are therefore being made for it to be held on the evening of November 16th next, at the Royal United Service Institution, where the Society's ordinary meetings are held. On this occasion the museum of the Institution will be thrown open to members and their friends, including ladies. The band of the 22nd Middlesex Rifles will be stationed in the museum, whilst other amusements of a suitable nature will be provided.

**Protection of Workmen on High-Tension Conductors.**—The New York *Electrical Review* says that the Association des Industriels de France Contre les Accidents du Travail will hold an international congress in Paris in June, 1905, for the purpose of investigating apparatus for ensuring the greater safety of workmen employed on high-tension conductors. The device will be expected to indicate safely and plainly whether a conductor is alive or not. It must be applicable to direct and alternating currents of all voltages and incapable of doing damage to itself, the conductor or distribution system. A prize of 6,000 francs will be awarded to the exhibitor whose apparatus best satisfies the qualifications, the system remaining the property of the inventor.

**The Arnold Traction System.**—A trial run was made on August 3rd on the Lansing, St. Johns and St. Louis Railroad, in Michigan, with the Arnold electro-pneumatic motor. The first motor was destroyed by fire on December 18th, 1903. Since that time, says the *Street Railway Journal*, Mr. Arnold has rebuilt the machine. The run on August 3rd, was made between De Witt and Lansing, a distance of eight miles, and at one time a speed of 25 miles an hour was obtained. The trolley voltage was about 6,000, and was carried the entire length of the line, a distance of 20 miles.

**Electrical Plant at Alfreton Ironworks, Derbyshire.**—The question of introducing electric power into these works was decided on in the beginning of the present year, and after careful consideration of different systems, orders were placed for the plant. Power is obtained from the waste gases from the blast furnaces, applied to a Babcock & Wilcox boiler, capable of evaporating 10,000 lbs. of water per hour into steam at a pressure of about 160 lbs. per sq. in. A superheater working in conjunction with this boiler raises the temperature of the steam to 500°. An engine and generator were supplied by Messrs. Belliss & Morcom, Ltd., of Birmingham, a high speed (425 revs.) compound condensing engine, being direct coupled to a continuous current dynamo (220 volts). The energy is distributed to the different parts of the works by bare copper cables, and will replace five large steam boilers and two gas engines. The whole of the motors, cables, and electrical equipment have been supplied and erected by the Electric Construction Co., of Wolverhampton. The foundries are equipped with electric cranes of 5, 8, 10, 15, and 25 tons capacity. The sections of plant have been made large enough to allow for contemplated extensions. The power house has been built so as to admit of a duplicate generating set, which will be installed later. Extensive new shops have also been built to the order of the firm by Messrs. Graham, Morton & Co., of Leeds.

**Smoke Nuisances.**—The Medical Officer of Health at Lambeth in his annual report just issued writes:—"Two memorials were received during the year drawing attention to the emission of 'grease,' 'blacks,' and smoke from the chimney belonging to the South London Electric Supply Corporation, Ltd., at Bengeworth Road Loughborough Junction. Since the magistrate imposed an exemplary fine upon this company (the magistrate's decision being upheld in the Court of Appeal) there has been a great improvement in regard to the black smoke nuisance. Steam is now used in large quantities, which, mixing with the black smoke in the chimney, gives it a greyish, brownish, or (at times) whitish appearance, thereby preventing black smoke appearing from the chimney shaft, and so rendering it impossible for further action to be taken under Sec. 24 (*b*) of the Public Health (London) Act, 1891. The memorialists complain not only of smoke, but of unburnt carbon and grease coming out of the chimney, more especially towards the latter part of the afternoon, a condition of things that may be due to the class of fuel which is burned in the furnaces about that time. Special observations are being made, and action will be taken if, and as may be, found necessary."

In his annual report just circulated, the Medical Officer of Health, at Hampstead, writes: "Serious complaints were received during the year, of the emission of considerable quantities of steam from the General Electric Supply Co.'s works, which was not only excessively laden with moisture, but also appeared to be charged with oily vapour. A notice was served upon the responsible person under Sec. 23 (2 c.) of the Public Health (London) Act, 1891, with the result that condensing plant has been erected, and no further complaints received."

**Submarine Bell Signals for the St. Lawrence.**—The Boston Submarine Signal Co., by agreement with the Canadian Government, is to install 30 bells in the St. Lawrence River and off the coast of the maritime provinces. Twenty-six of the stations will be worked from shore, and four from lightships. In order to use the system ships are equipped with telephone receivers, which pick up the sounds of the bells at a distance of four to ten miles. The system has been tested by the officers of the Navy Department, the Lighthouse Board, and a number of steamship companies, and they unite in pronouncing it a most important invention.

**Fatalities.**—An electrician and a flagman in the employ of the Underground Electric Railways Co., in connection with the electrification of the District Railway, were run over by a gas train shortly after 1 a.m. one day last week and killed, while engaged in the tunnel. The jury in one case found that insufficient flagmen were employed to signal to workmen when trains were approaching; and in the other case they recommended that when men were working, both up and down lines should be blocked.

**Modern Power Houses.**—What will our American friends say to Mr. B. H. Thwaite's assertion that "If New York has been embellished and structurally ennobled by the steel-frame system, the ancient city of York probably possesses the first actual example of the basis of the system. It appears that in the fifties, Mr. Pritchett, a Yorkshire architect, designed a retreat, belonging to the Society of Friends, which was constructed in the ancient city of York, in which he embodied iron girder and brick arch floor. The floors, too, of the Saltaire Mills, Saltaire, Yorkshire, are formed of iron joists and intervening hollow brick arches." It may be said that it is during the last eighteen years that the steel-frame building has attained such importance, and whatever may be said by architects of the old school concerning the want of beauty in such erections, this, at least, may be claimed for the steel frame—it has extended the safety limit of building height by an additional 20 storeys. One of the latest uses to which steel structural work has been put, is its employment in the building of power stations for the reception of large electric plants. The question of the suitability of the type of building to the purpose for which it is designed, is one that constantly engages the earnest thought of such as are responsible for the design. Why we never woke up before to the fact that steel-frame buildings are admirably adapted for the repositories of power plant is one of those surprising psychological problems that are a distinguishing feature of the present day. It has been said that in the multitude of counsellors there is wisdom. But we look in vain for the "wisdom" in the erection of power-station houses that, while admitting the necessity for solidity and adaptability in the building, is yet able to select a type of structure which shall avoid the outlay of large sums of money and the unnecessary locking up of vast capital in brick and mortar enterprises. To put up a building, solid and substantial, and in every way fitted to the purpose for which it is required at less than half the usual cost, and, furthermore, to erect it in less than half the time, and to render it safe at five or six times the average height, requires a practical "wisdom" that our corporations have yet to exhibit. But, the idea is abroad, and who can tell into whose brains it may find an entry? It might even afflict the City Fathers, and make uneasy members of municipalities. If it be true that corporations and municipalities should so regulate the prices of the commodities they supply, as while covering cost yet to make no profits, it is equally true that their initial building outlay should be as low as is consistent with the erection of well-built power-houses, carefully designed to best fulfil the purpose of their existence. And here we may say that it is not necessary, in substituting steel for brick, that the same style of architecture should be invariably selected. The lines of the buildings are essentially shaped by the plant itself, and the architectural treatment is necessarily subservient to the engineering requirements. It is noteworthy that Messrs. Graham, Morton & Co., of Leeds are turning out excellent work of this kind.

**The Lohnstein Element.**—As described by the inventor, this primary battery consists of carbon and magnesium electrodes in a solution of potassium bichromate containing hydrochloric acid. The E.M.F. is about 3 volts, but soon falls off to 2·7, where it remains constant. The voltage seems rather gamey!

**Lucal System of Oil Fuel.**—In the Lucal oil-burning system the oil is partially vaporised, and the unvaporised portion is ejected at a high temperature, mixed with the vapour and with air. The motive power is steam, at 30 lbs. pressure or more and highly superheated, and it is used to the extent of 1½ per cent. of the total steam formed. The oil may be crude or refined, and it is fed by gravitation. This method of feeding is condemned by the best authorities, and pumps are advised by which the oil is lifted to the furnace so as to avoid the dangers incidental to gravitation.* Special pumps are always supplied in America for this purpose, and the fire underwriters insist on it.

The circular before us makes a claim for an efficiency of 100 per cent., and refers to Prof. Watkinson's report in support of this. We have referred to this report, and find that the efficiency found by the learned Professor was 75 per cent. only, but his report was put together in a style involving ambiguity, and there is certainly an excuse for a non-technical reader to fall into the quite natural error of supposing that the Professor had claimed 100 per cent. efficiency. We do not place much value on Prof. Watkinson's report so far as the more hypothetical portion is concerned, but there is nothing unreasonable in the results he actually did obtain of 75 per cent. efficiency. But in his subsequent note he has evidently so worded matters that his clients have been led to suppose he found an efficiency of 100 per cent. We see no reason to doubt the value of the Lucal system, but are of opinion that when a professor of engineering, trenches on the preserves of the consulting engineer, he should make out his report in such a way as to convey the truth in the plainest possible manner, with a minimum risk of error. A little more attention to this point would have prevented his clients from making a claim for their system that is at once practically impossible of realisation. Tables of figures should not have their headings or side lines arranged in the form of an argument.

The circular contains no description or drawing of the apparatus beyond a photographic view of the boiler on which it was tested. The Lucal system of liquid fuel burning may be good, but it is not described in the circular, and a really good description would have been of interest.

**The Erosive Effect of Powder Gases on Gun Linings.**—In the discussion on several papers before Section G of the British Association, Prof. Hopkinson is reported to have said that the erosive action of gases due to their motion had a powerful effect in guns, and this was another evidence of its energy. In this contention there appears a good deal of misapprehension. Guns are not eroded by the energy of the moving gases, but because the gases are very hot. If the gas check at the back of a shot did its duty, there would, it is said by a leading gun expert, be no erosion. The temperature of the powder gases is very high. In the chamber, the gas in contact with the wall of the chamber is rapidly cooled, and shields the metal from the remainder of the gases. If the gas check behind the shot is bad, and allows gas to escape past the moving shot, the gas will certainly cause erosion. This erosion, however, is not due to flow of gas, but because the gas, being permitted to flow past the shot and over the surface of the bore, continually washes the bore with a long stream of hot gas, and this long-applied heat melts away the metal of the gun. Erosion is, therefore, a temperature effect, rather than an effect of mechanical energy. Stop the flow of the hot gas, and the erosion would cease, for this is not so much due to the motion of the gas as because of that motion which permits a long-continued supply of heat at one locus. This is a different matter entirely. Cold gases not charged with dust would probably erode slightly, or not at all. The erosion of a stream of hot gas is similar to the action of a very fine jet of hot water upon a large block of ice. This will cut deep grooves in the ice. A mere stationary film of hot water would assume the temperature of the ice.

**Electrolytic Oxidation of Anthracene.**—A. Fontana and F. M. Perkin have described (*Elektrochem. Zeits.*, 1904, xi., 99) an electrolytic process for the oxidation of the coal tar hydrocarbon anthracene into anthraquinone (which is the intermediate product in the usual chemical method of preparing the Turkey-red dye, alizarine, from anthracene). The electrolyte is a solution of 10 grammes of anthracene in 550 cc. of acetone and 100 cc. of a sulphuric acid containing 40 cc. of the strong acid, and 60 cc. of water. This liquid becomes clear when warmed. With the aid of platinum electrodes, a current of electricity (but no measurements are recorded) is passed through the bath for a somewhat longer time than is necessary for the oxidation; the whole is left standing over night, when a large quantity of anthraquinone separates. A lead anode gives a better yield, but the product is always very dark in colour. The cathode should be kept in a state of rotation. Among possible carriers of oxygen, the authors have only obtained satisfactory results with potassium bichromate, maganates, or permanganates, and cerium sulphate, the manganese compounds being the best. The process works equally well in the presence or absence of a diaphragm.

**Supply of Platinum.**—Our New York namesake says that in view of the constantly increasing demand for platinum and the limited supply, the source being almost entirely restricted to the Ural Mountains, in Russia, "it is very probable that the price will increase. The Russian-Japanese war is beginning to have its effect."

**India-Rubber Production and Prices.**—The Hamburg firm of Hecht, Levis & Kahn have issued statistics relating to the production and price movement of rubber during recent years. The figures, as quoted by the *Frankfurter Zeitung*, show that the total world's production of rubber amounted to 61,759 tons in 1903-4, as compared with 55,603 tons in 1902-3, while the total consumption reached 59,666 tons, as against 55,276 tons. In Europe alone the arrivals comprised 33,027 tons, as compared with 29,268 tons, and the deliveries represented 26,236 tons, as against 31,047 tons, while stocks declined from 3,110 tons to 2,996 tons. The supplies of Para rubber, which only amounted to 19,730 tons in 1893-4, advanced to 22,315 tons in 1896-7, 27,640 tons in 1900-1, 29,800 tons in 1902-3, and 30,580 tons in 1903-4. In regard to prices, the diagram prepared by the Hamburg firm indicates that the highest level in the four years ended with 1903, was attained in September, 1900, when the quotation was 4s. 3¾d. The 1900-1 campaign ended with a price of 3s. 9½d., and that of 1901-2, with a quotation of only 2s. 11½d. In 1902-3 an upward movement took place to 3s. 11d., and in 1903-4, the price fluctuated considerably. The highest point of 4s. 11d. was reached in May and June and closed at 4s. 9½d., as compared with 3s. 11½d., and 2s. 11½d. in the corresponding months of 1903 and 1902.

* See "Liquid Fuel and its Combustion." Constable & Co.

**Mechanical Draught for Boilers.**—Mr. W. Yates, who presented a paper on this subject at the summer meeting at Liverpool of the Institution of Heating and Ventilating Engineers, commenced with an introduction on general principles. At the end of the paper some acknowledgment is made to Mr. Snow for culled extracts, but there is a good deal in the paper which we seem to have read before by another writer, for which no acknowledgment is tendered. The remainder of the paper contains descriptions of fan-draught installations, showing position of fan relative to driving, &c. The advantages of mechanical draught are dwelt upon, especially in regard to the reduction of first cost as compared with chimneys, and generally the paper is a useful statement of the advantages of fans, as compared with chimneys.

**Third Rail Accidents.**—"Landowner," writing to the *Times* regarding the Board of Trade reports which appeared in our last issue, says that these "appear to deal chiefly with trespassers," and he proceeds:—"Their recommendation that special precautions should be taken at the points where trespassing is habitual is good so far as it goes, but there are other cases which should be considered. (1) Children wandering in search of wild flowers (they scarcely come under the head of trespassers), who are ignorant of the danger they incur and do not, or cannot, read notice boards. (2) Passengers, in case of an accident, having to scramble out of the carriages as best they can. (3) Cattle and horses straying on the railway in consequence of broken fences, or gates being left open. There was a case a few days ago of a horse being killed from this cause near Wallsend. (4) Dogs belonging to farmers and shepherds, cattle and sheep being moved across the railway, and straying along the line. (5) All game and hounds crossing the railway." The writer concludes that "to satisfy the public the 'live rail' must be protected throughout the entire length of the railway."

**Steam Roller v. Tramcar.**—A collision between a steam roller and an electric tramcar would hardly add to the beauty of either, and we should, at least, expect that the car would be the greater sufferer. Yet exactly the contrary was the case recently on the Leeds and Wakefield Light Railway, when one of the cars on the newly-opened lines came into violent collision with a steam roller. The roller was reduced to a hopeless wreck, while the car received only superficial damage. The result of the accident demonstrates in a remarkable manner, the strength and stability of the modern electric car.

**A Year's Coal Output.**—With the annual statistical tables, relating to trade in coal in the British Empire and the principal foreign countries for 1903, Mr. H. Llewellyn Smith, in his general report, gives a table showing that the production of coal in the five principal coal-producing countries of the world in 1901, 1902, and 1903, was:—

| Years. | United Kingdom. | Germany. | France. | Belgium. | United States. |
|---|---|---|---|---|---|
| | Tons.* | Tons.† | Tons.† | Tons.† | Tons.* |
| 1901 .. .. | 219,047,000 | 108,539,000 | 31,634,000 | 22,213,000 | 261,847,000 |
| 1902 .. .. | 227,695,000 | 107,474,000 | 29,865,000 | 22,877,000 | 269,277,000 |
| 1903 .. .. | 230,334,000 | 116,638,000‡ | 34,318,000‡ | 23,912,000‡ | 320,983,000 |

* Tons of 2,240 lbs. † Metric tons of 2,204 lbs. ‡ Provisional figures.

Export figures for the United Kingdom, Germany, and the United States (provisional only) are given for 1903 as follows:—

| — | Imports. | Exports. | Excess of exports. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| United Kingdom .. .. | 3,000 | 63,805,000 | 63,802,000 |
| Germany .. .. | 7,284,000 | 20,808,000 | 13,524,000 |
| United States .. .. | 3,358,000 | 8,312,000 | 4,954,000 |

The total exports of all these three countries in 1903 were the greatest recorded, but the net exports of the United States were not so great as in 1900 or 1901.

**Appointments Vacant.**—Shift engineer for Dublin (£104); shift engineer for Ipswich (£90); an assistant book-keeper for Leyton U.D.C. (£60 rising to £120); shift engineer for Loughborough (35s.), also fitter driver (36s.).

**Electrolytic Recovery of Tin from Scrap.**—A process has been worked out by H. W. Hemingway for the above purpose, which runs as follows:—The tin is stripped in an acid solution of ferric sulphate, or in a solution of sodium nitrate to which some sulphuric acid has been added. The metal is then thrown down electrolytically with an iron anode and a copper cathode. The solution of ferrous sulphate which results can be oxidised again by the action of sodium nitrate and sulphuric acid at a temperature of 60° C. The compounds of nitrogen liberated are converted into nitric acid.

**Motor-Cars.**—A Parliamentary return just issued relating to motor-cars shows the number of motor-cars, distinguishing motor-cycles from other motor-cars, registered by each registering authority in the United Kingdom under the Motor-car Act, 1903, up to January 1st, 1904, and April 1st, 1904, respectively. The total number of motor-cars registered up to January 1st, 1904, was:—Motor-cycles, 5,121; other cars, 8,400; total, 13,521. Up to April 1st, 1904, motor-cycles, 16,534; other cars, 14,887; total, 31,421.

**The McMurtrie Electric Timing Clock.**—A new electric timing device, invented by Mr. A. L. McMurtrie, of Baltimore, Md., was used for the first occasion for the timing of the automobile races at Long Branch, N.J., on Monday, August 15th. The McMurtrie electric clock is an arrangement of comparatively simple electro-magnetic mechanism. The apparatus is mounted on a board about 3 ft. square. Under the operator's left hand is an ordinary telephone connection, and at the right are five stop-watches in a row in front of a similar number of plungers fitted with hard rubber heads. The rest of the board is occupied by three relays, the distributing device, a timing key and switches, the necessary batteries being stowed away beneath. The manipulation of a key at the starting point, which may be at any distance from the recording apparatus, so long as a circuit can be established, starts all the watches simultaneously, and any watch, according to prearrangement, can be stopped when the car passes the quarter-mile, the half, the kilometre, the three-quarter and the finished, or any other distances that may be selected along the circuit wire, only one circuit being needed for any number of successive observation points. If desired also, any number of watches can be used instead of five.

The distributor is essentially a brass wheel about 10 in. in diameter, placed horizontally in a small box. The spokes of this wheel—if spokes they may be called—are each pierced with 10 contact holes, into which fit movable brass plugs, and the plugs can be arranged in a great number of possible combinations, according to the number of the observation stations and the number of stop-watches. Assuming that the conditions of a race are as indicated above, one of the spokes is fitted with five plugs, and the signal from the starting point of the race leads to the distributor a current which moves the wheel forward, flows through the plugs and starts the watches. When the operator at the quarter-mile sees the leading car approaching, he presses his key; this key operates the distributing relay on the board, and brings forward a second spoke on which is a plug corresponding with the first watch. This movement of the wheel closes a circuit which operates a second relay, and in turn sets the spring of the watch plunger. As the car passes the mark at the quarter-mile, the observer lifts his finger from the key and breaks the circuit, which in turn releases the plunger spring and instantaneously stops the watch. The signals are given in the same manner at the other distances. A third relay is attached to the apparatus, and can be used for firing a pistol, so that timing can be accomplished by the older method. For the Long Branch tests, an ordinary telephone circuit was used for the timing signals. The telephone was used for speaking all the time the signals were being given, and the results were telephoned back from point to point the instant the watches gave their indications.

An additional attachment to the apparatus is a steel tape, which can be stretched across an automobile track about 3 in. from the ground. The tape is kept steady by a set of special springs, and a movement of $\frac{1}{16}$ in. will cause the tape to close a recording circuit, so that when the tape is used the timing of a race is absolutely automatic as far as the leading car is concerned; but, as at present arranged, the time for the second or any succeeding car can only be taken by resetting the distributor after any particular watch is stopped. In automobile races, the time for the leading car is, of course, the most important, and the times of the following cars could be easily taken by hand from point to point with independent watches, started simultaneously with the electric recording signal.

## OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

**Central Station Engineers.**—At a meeting of the Heckmondwike U.D.C. on Monday, it was reported that the electrical engineer, Mr. G. H. Carter, had withdrawn his resignation on the terms of the resolution passed at the previous meeting, viz., that his salary be advanced from £200 to £250 on condition that he remained with the Council two years. As previously stated, Mr. Carter had secured the post of electrical engineer to the Acton (Middlesex) U.D.C.

The members of the electrical department of the Sunderland Corporation made a presentation on Saturday to Mr. W. A. Thompson, who is leaving to take up a position at Tynemouth.

On the 16th ult. Mr. F. A. Bond, chief assistant at Ilford, was appointed resident electrical engineer to the Heston and Isleworth Council.

**Electric Tramway Officials.**—On Monday evening, at a meeting of the Huddersfield Tramways Committee, it was resolved to place on record the Committee's appreciation of the faithful, efficient and valuable services of Mr. H. N. Thomas, the general manager, together with the desire of the Committee to congratulate him upon having obtained a similar appointment at Durban, and to wish him health and success there. On behalf of the Committee, the Mayor (Alderman R. H. Inman) presented a piece of silver plate to Mr. Thomas, to which the chairman said every member of the Committee had subscribed.

The Tramways Committee of Huddersfield T.C. on Monday appointed Mr. R. H. Wilkinson, general manager of the Oldham Corporation Tramways, as tramways manager at a salary of £350 per annum.

At a meeting of the Belfast Corporation Tramways Committee on the 29th ult., Mr. Andrew Nance, the present manager of the tramway, was nominated by a majority to continue the management after the Corporation takes over the system.

**General.**—Our Durban correspondent reports that Mr. J. Hubert Davies, of the firm of Messrs. Hubert Davies & Spain, electrical engineers, of Johannesburg and Durban, recently left for England, with a view of opening a buying house in London.

Mr. G. R. Drummond, A.M.I.E.E., has resigned the appointment of electrical engineer to the Bombay, Baroda and Central Indian Railway, and has taken up an appointment as electrical and mechanical engineer to the Birkaneer State, Rajputana.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**D.P. Battery Co., Ltd.** (44,084).—This company's annual return, dated August 3rd, has been filed. The entire capital of £10,000, in 4,996 "A," 4,996 "B," and eight other shares of £1 each, has been taken up and paid in full. Mortgages and charges: £20,000.

**Mexico Electric Tramways, Ltd.** (56,932).—This company's annual return, dated June 23rd, has been filed. The entire nominal capital of £1,000,000, in 500,000 ordinary and 500,000 preference shares of £1 each, has been taken up. £500,000 has been received in respect of the preference shares, and £500,000 is considered as paid on the ordinary. Mortgages and charges: £400,000.

**Thomas Parker, Ltd.** (40,973).—This company's annual return, dated July 18th, has been filed. The entire nominal capital of £75,000, in 7,500 shares of £10 each has been taken up. £10 per share has been called up on 5,750, and £57,500 has been received. £17,500 is considered as paid on 1,750. Mortgages and charges: £60,000.

**Northern Counties Electricity Supply Co., Ltd.** (67,924).—Issue on August 10th of £40,000 5 per cent. mortgage debentures, part of series created February 18th, 1901, to secure £100,000. Property charged: the company's undertaking and property, present and future, except uncalled capital. Holders: J. D. Milburn, Queen Street, Newcastle-on-Tyne, and the York City and County Banking Co., Ltd., Newcastle-on-Tyne. No trustees. Previously issued of same series: £26,100.

**Hodge & Co., Ltd.**, gas and electrical engineers, London (78,567).—A first mortgage debenture, dated July 27th, 1904, to secure £250, charged on the company's undertaking and property, present and future, except uncalled capital, has been registered. Holder: D. S. Hodge, Down Hall, Bradwell-on-Sea.

**Bath Electric Manufacturing Co., Ltd.** (78,083).—Issue on August 17th of £150 4 per cent. debentures, part of series created July 19th, 1904, to secure £1,000, charged on the company's undertaking and property, including uncalled capital (if any). No trustees. Previously issued of same series, £800.

**Edmundson's Electricity Corporation, Ltd.** (52,013).—An acknowledgment of indebtedness, dated August 19th, 1904 (supplemental to a trust deed dated July 10th, 1899, and four deeds of acknowledgment dated respectively April 27th, 1900, August 1st, 1901, November 14th, 1902, and September 28th, 1903, securing debenture stock to an amount not exceeding three-fifths of the paid-up capital for the time being) has been registered. Property charged: 130 first mortgage debentures of £100 each of the Winchester Electric Light and Power Co., Ltd., 150 similar debentures of the High Wycombe (Borough) Electric Light and Power Co., Ltd., 200 similar debentures of the Salisbury Electric Light and Supply Co., Ltd., 150 similar debentures of the Ventnor Electric Light and Power Co., Ltd., 100 similar debentures of the Bromley (Kent) Electric Light and Power Co., Ltd., 40 similar debentures of the Woolwich District Electric Light Co., Ltd., 50 similar debentures of the Chislehurst Electric Supply Co., Ltd., 40 similar debentures of the Newmarket Electric Light Co., Ltd., 50 similar debentures of the Alderley and Wilmslow Electric Supply Co., Ltd., and the company's undertaking and general assets, present and future. Trustees: J. Bailey, 102, Eaton Square, S.W., and the Anglo-American Debenture Corporation, Ltd., 75, Lombard Street, E.C. Total amount of debenture stock previously issued: £800,000. (Note: The last return gives capital paid up in cash as £684,000; considered as paid, £66,000.)

This company's annual return was filed on August 19th, when 70,000 ordinary and 7,000 preference shares had been taken up out of a nominal capital of £800,000 in 70,000 ordinary, 70,000 preference, and 20,000 reserve shares of £5 each; £5 per share has been called up on 70,000 preference and 56,800 ordinary shares, resulting in the receipt of £634,000; £66,000 is considered as paid on 13,200 ordinary shares. Mortgages and charges, £305,772.

**Bath Electric Manufacturing Co., Ltd.** (78,083).—Issue on August 20th of £100 debentures, part of series created July 19th, 1904, to secure £1,000, charged on the company's undertaking and property, including uncalled capital. No trustees. Previously issued of same series, £450.

**Moelline Co., Ltd.,** electrical and general engineers, London (76,689).—Issue on August 3rd of £625 debentures, part of series authorised March 29th, 1904, to secure £15,000, charged on the company's uncalled capital (if any), patents, property, undertaking, &c., present and future. No trustees. Previously issued of same series £12,875.

## ELECTRIC TRAMWAY ACCOUNTS.

**Newcastle-on-Tyne and Portsmouth Corporation Tramways.**

Some 11 months ago we had occasion to comment on the returns of these tramway undertakings, as they were then comparatively young to electric traction, but obtaining excellent results therefrom.

The results of another year's operations amply justify the expectations then held out. Newcastle has increased its mileage and services, and Portsmouth has similarly dispensed with its last horse car; in the former city the total average working expenses show an increase per car-mile, due to the heavier items for rates, taxes, and maintenance and renewals, while the items for financial charges and revenue per car-mile are nearly stationary; in the southern undertaking, average working expenses are fractionally higher, but are more than balanced by the reduced average of the financial charges; here, however, reduced earnings per car-mile, though still above the average, have pulled down the balance somewhat, compared with the previous year. The surplus remaining, however, is a very satisfactory one.

Both undertakings generate their own power, not, however, exclusively for their own traction purposes; Newcastle, with works costs of ·36d. per unit, and Portsmouth at ·55d. per unit, and this no doubt assists them in obtaining the very creditable results which they achieve under conditions demanding frequent and extended services. The results, in tabulated form, are as follows:—

NEWCASTLE-ON-TYNE CORPORATION TRAMWAYS.

| For 12 months ending March 25th. | 1904. | 1903. |
|---|---|---|
| Length of route | 23 | 19 miles |
| Total length of track | 45 | 38½ „ |
| Average number of cars in use | 165 | 140 |
| Car-miles run | 4,059,907 | 3,379,119 |
| Passengers carried per annum | 39,715,120 | 33,474,122 |
| Capital expended to date | £1,054,493 | £903,594 |
| Traffic receipts | £180,631 | £150,334 |
| Total „ | £185,028* | £153,822* |
| Working expenses | £121,558* | £89,313* |
| Gross profit | £63,470 | £64,509 |
| Income per car-mile | 10·94d. | 10·93d. |
| Working expenses per car-mile | 7·19d.† | 6·35d. |
| Interest and sinking fund per car-mile | 3·05d. | 3·04d. |
| Total expenses per car-mile | 10·24d. | 9·39d. |
| Profit or loss per car-mile | +·70d. | +1·54d. |
| Cost of energy per car-mile | ·58d.* | ·62d.* |
| Average fare per passenger | 1·1d. | 1·08d. |
| „ „ charged per mile | — | — |
| Revenue per mile of route | £8,045* | £8,096* |
| Expenditure per mile of route | £5,285* | £4,700* |
| Total units used | 7,757,885 | 6,063,570 |
| Units used per car-mile | 1·91* | 1·79* |
| Percentage of working ex'es to receipts | 66 % | 58 % |

* Includes public arc lighting. † 7·00d., excluding proportion of costs chargeable to street lighting.

Profit Statement.

| | |
|---|---|
| Interest on loans | £28,896 |
| Sinking fund | 22,638 |
| Surplus on year's working | 11,936 |
| Gross profit | £63,470 |

The surplus was applied in conjunction with a balance of £7,677 from the previous year as follows:—£15,000 to repayments to city fund and the balance of £4,612 carried forward. The general manager and engineer is Mr. A. E. Le Rossignol.

PORTSMOUTH CORPORATION TRAMWAYS.

| For 12 months ending March 31st. | 1904.† | 1903.* |
|---|---|---|
| Length of route | 14½ | 14½ |
| Total length of track | 28½ | 28½ |
| Average number of cars in use | 81 | 80 |
| Car-miles run | 1,828,193 | 1,628,749 |
| Passengers carried per annum | 18,204,426 | 16,355,692 |
| Capital expended to date | £634,406 | £620,238 |
| Traffic receipts | £87,266 | £74,474 |
| Total receipts | £92,917 | £77,804 |
| Working expenses | £43,427 | £36,961 |
| Gross profit | £49,490 | £40,843 |
| Income per car-mile | 12·19d. | 12·37d. |
| Working expenses per car-mile | 5·7d. | 5·44d. |
| Interest and sinking fund per car-mile | 4·39d. | 4·68d. |
| Total expenses per car-mile | 10·09d. | 10·12d. |
| Profit or loss per car-mile | +2·10d. | +2·25d. |
| Cost of energy per car-mile | ·55d. | ·76d. |
| Average fare per passenger | 1·14d. | 1·1d. |
| Revenue per mile of route | £6,408 | £5,790 |
| Expenditure per mile of route | £2,995 | £2,543 |
| Total units used | 2,695,605 | 1,778,266 |
| Units used per car-mile | ·97 | 1·03 |
| Percentage of working ex'es to receipts | 46·7 % | 44 % |

† Includes 497 miles horse traction. * Includes 42,424 miles horse traction.

Profit Statement.

| | 1904. |
|---|---|
| Interest on loans | £18,343 |
| Sinking fund | 15,119 |
| Surplus on year's working | —16,028 |
| Gross profit | £49,490 |

The year's surplus was added to the reserve fund, which now amounts to £22,993. Mr. W. R. Spaven is the general manager.

## CITY NOTES.

### Chatham and District Light Railways Co.

This company held its meeting at 83, Cannon Street, E.C., on Wednesday, Mr. A. R. Monks presiding. The directors' report for the half-year ended June 30th, 1904, which was adopted, stated:—

The result of the half-year's working is as follows:—

| | | |
|---|---|---|
| Receipts | | £14,972 17 2 |
| Expenses | | 11,215 8 4 |
| | | £3,757 8 10 |
| Add balance brought forward from December 31st, 1903 | | 556 6 9 |
| | | £4,313 15 7 |
| Less interest on debentures | £1,000 0 0 | |
| Interest on Lloyds' bonds | 488 6 6 | |
| | | 1,488 6 6 |
| | | £2,825 9 1 |

Of this amount:—

| | |
|---|---|
| £205 6 10 | has been written off as per revenue account. And the directors recommend that the balance be disposed of as follows:— |
| 1,875 0 0 | to dividend at the rate of 5 per cent. per annum on the preference shares for half-year ended June 30th, 1904. |
| 745 2 3 | to revenue new account. |
| £2,825 9 1 | |

In submitting the accounts, the directors are pleased to say that the receipts continue to show progress. It is proposed to write off the cost of the abandoned Westcourt Street route in five years, and, as will be seen, £205 6s. 10d. has been written off same in the accounts for the past half-year. The doubling of the track at Chatham Hill, referred to in the previous report, has been completed. The Corporation of Rochester having decided to proceed with the construction of certain of their lines, the company are placing orders for construction of the line from Railway Street to connect with New Road. The directors recommend that the dividend on the preference shares be paid on September 1st next.

### Bury, Rochdale and Oldham Tramway Co.

The report for the half-year ended July 31st last, to be submitted at the meeting at Manchester to-day, shows a gross profit of £2,651. The directors recommend the addition of £1,307 to debenture interest fund, which, with the sum of £15 balance brought forward, enables the payment of £2 11s. 8d. per cent. per annum, and leaves £13 to be carried forward, and the appropriation of £1,344 as dividend for the shareholders, which, with £35 balance brought forward, enables the payment of 6½ per cent. per annum, and leaves £14 to be carried forward. As regards the sale of the company's undertaking, since the issue of the last report an arbitration of the whole of the company's property has taken place, Mr. H. Graham Harris being the referee appointed by the B. of Trade. His award was made known on 13th ult., and on the same date the directors informed the shareholders that the sum awarded (exclusive of £3,600 for street improvements, which was then in dispute) was £159,075. With regard to the £3,600, the purchasing authorities made a proposal to pay a portion of the amount by way of compromise, but the directors held that the company was entitled to the full amount, and were unable to accept the proposal. The authorities have since intimated that they will pay the whole of the £3,600. With regard to the company's tramway in Whitefield, it was stated in the last report that owing to the differences which had arisen with the D.C. of Whitefield, the tramway in their district would not be included in the arbitration. Those differences were subsequently amicably arranged, the Council agreeing to pay to the company the sum of £350, and the tramway in Whitefield was accordingly included in the arbitration with the rest of the company's undertaking. This sum of £350, added to the award of Mr. Graham Harris, makes a total of £163,025. The directors are unable to say whether the sale will be completed within three months from the publishing of the award, but, if not, the purchase

money will, after the expiration of that period, carry interest at the rate of 5 per cent. per annum, which interest will take the place of £5,300 now receivable in lieu of profits on working.

## Chilian Electric Tramway and Light Co.

The report for 1903, presented at the meeting held on August 24th, shows, after payment of interest due on loan account and other charges, a balance to credit of £1,946. From this is deducted the debit balance brought forward from the previous year of £324, leaving a net balance to the credit of profit and loss account of £1,621 to be carried forward. During the twelve months a net profit on the operation of the tramways was made of $512,195, from which was written off the sum of $179,469, being for amortisation of the horse account, and sundry incidental expenses in connection with construction outlay. The net profit for 1902 was $271,058. The above large amortisations, being of an exceptional character, will not reappear in future accounts. The number of passengers carried was 52,427,358, an increase of 7,251,442. During 1903 the electric lighting department earned a net profit of $179,723, against $113,390 in 1902. This result, although showing an advance on the previous year, still falls far short of the expected development of the lighting business, which the directors hope yet to realise, the capacity of the plant being far in excess of the present consumption. As indicated in last year's report, the capital of the company was increased by the creation of £100,000 additional 6 per cent. cumulative preference shares, ranking *pari passu* with the existing preference shares. £50,000 of the above shares have since been issued.

## Fire-Resisting Corporation, Ltd.

At the statutory meeting held on Tuesday at the Cannon Street Hotel, Mr. E. M. Fox, the chairman, said that the works at Fulham continued to be very busy treating wood for the new electric carriages of the Metropolitan District Railway Co. They had in hand sufficient orders in this department to keep them fully employed for several months. The margin of profit for the same was small, but the directors were in hopes that, when the advantages of the wood became better known and its merits were thoroughly appreciated, they would be able to raise the price above that which was now being charged. The plant which, during the last few months, they had been erecting at the works of a large French carbuilding establishment, was now well advanced.

## Angus Electric Light and Power Co.

At an extraordinary general meeting held on Monday, it was decided to alter the name of this company to the North of Scotland Electric Light and Power Co., Ltd, to increase the ordinary share capital to £100,000, and to issue £25,000 of debenture stock. These important steps have been taken in view of arrangements being made for taking over the provisional order for supplying electricity to Inverness. The increase of capital was imperative, owing to the Inverness developments, and the extensions recently carried out and in contemplation in Montrose and Brechin, where the company, under its former title, has made excellent progress since its inception.

**W. T. Henley's Telegraph Works Co.**—The directors have declared an interim dividend on the ordinary shares at the rate of 10 per cent. per annum, less income-tax, for the half-year ending June 30th last, payable September 2nd. This compares with an interim dividend at the rate of 12 per cent. per annum last year.

**Change of Name.**—The County of Surrey Electrical Power Distribution Co., Ltd., of Donington House, W.C., has changed its name to "The South Metropolitan Electric Tramways and Lighting Co., Ltd."

**Stock Exchange Notices.**—The Committee has appointed a special settling day as under:—Wednesday, September 7th: North Wales Power and Traction Co., Ltd.—34,100 shares of £5 each, £4 paid, Nos. 1 to 34,000 and 37,401 to 37,500; and has also ordered the undermentioned to be quoted in the Official List:—Metropolitan District Railway Co.—£500,000 4 per cent. perpetual debenture stock, in lieu of the scrip now quoted.

**Hardy Patent Pick Co.**—The report for the year ended June 30th states that the profits amounted to £7,011, and with the balance from the previous year, there is an available total of £8,005. A dividend of 2½ per cent. is recommended on the ordinary shares, leaving £2,259 to carry forward. Owing to the depression in the coal and other mining industries, the sales were considerably less than in the previous year.

**A Private Issue.**—The *Morning Post*, in its City article for August 30th, states that without any public announcement an important issue of debentures has been placed among some of the insurance companies and finance houses in the City:—"Money was wanted for the provision of the new electric power station at Chelsea, which is to supply current to the Metropolitan District and others of the electric railways that are to be. To meet the necessary requirements, £750,000 4½ per cent. debenture bonds in a new company, with a currency of 10 years, have been placed at 96. No underwriting commission was paid, and the support of the public will, we understand, not be sought."

## STOCKS AND SHARES.

Wednesday Evening.

Rid of part at least of their political anxieties, the Stock Exchange markets step more cheerfully into the new month. The war, of course, remains the principal bugbear, as regards an increase both in speculation and investment. But with the practical conclusion of the holiday season, the City finds a less pessimistic tone abroad, and purse-strings show a loosening that already makes its influence felt upon stocks and shares all round the House. Electrical securities are remarkably apathetic this week, but since the majority of their prices remained steady through the dullest time in other sections, it may be that their turn to take an active share in business will find itself postponed for a week or two. As a matter of fact, business, while certainly better, is still confined to narrow circles.

By one of their sudden changes of fortune, Home Railway stocks have shot into favour, prices in this department being substantially higher on the week so far as the steam rails are concerned. But Metropolitan Consolidated is 2 better at 93½, and the Surplus Lands stock stands now at 74. Districts put on 1¼ at 38; the buying is reported to come from inner circles, which would like to see the stock better before the electrification, so that any public buying encouraged by the event will not get in at too cheap a rate. Great Northern and City have risen another ¼ at 4¾, at which business was done the other day. The scrip certificates of the Great Northern, Piccadilly and Brompton line are 9½ for the £10 shares. City and South London Ordinary stock stands at 41, at which price there are buyers in the market. Central London stocks have not moved. Underground Electric 5 per cent. profit-sharing notes remain about 97½.

Details have commenced to leak out with reference to the company that has been formed to run the Chelsea station, from which some of the electrified lines will draw their power. The public are not in this deal, and we understand that the three-quarters of a million pounds in 4½ per cent. 10-year Debenture bonds, issued at 96, have all been raised privately. Until we have the papers, it is impossible to criticise the nature of the security; but from what we learn, and, inferentially, from the subscription of the full amount by private sources, we should say that the bonds are excellent. We have heard a little disappointment expressed at the absence of underwriting, but this is a good feature rather than the reverse.

In the electrical supply group, the only noticeable change is a rise of 10s. in St. James's and Pall Mall Ordinary, which leaves them at 15. On several recent occasions attention has been directed to the hardness of the market in these shares. There is a little business doing in Metropolitans round about 16¼, equivalent, of course, to 22¼, allowing for the return of capital. This is practically the highest price the shares have reached, although in 1898 the quotation touched 21¾. For recent years the low-water mark was recorded in March, 1893, when the shares could have been bought at 5⅝, the company for that year paying a dividend of 2½ per cent. The comparison of Metropolitan Electric prices lures one on to recalling how City of London Ordinary rose to 30⅜ in January, 1898, although the dividend for that year was no more than 6 per cent. Only eighteen months after, the dramatic drop occurred which left the shares at 10¼, a fall of £15 10s. occurring within three months. But reminiscence, given a free rein, is apt to become a nuisance. Charing Cross are ¼ better at 8, Urbans have also risen, ¼ to 5, and so have London Electrics at 1⅞.

Henley's are quoted *ex* the interim dividend at the rate of 10 per cent., and continue a firm market at 11 *xd*. British Insulated Wire are still *cum*. their recently declared dividend at the rate of 8 per cent. A drop of 3 points has reduced Crompton Debentures to 92½; the quotation has been a trifle unsteady for some time past. British Westinghouse Preference hug 3 very closely, and Thomson-Houston 4½ per cent. Debenture at par is just *ex* interest. A slight rise in Babcock & Wilcox Ordinary makes the price 3½, the Preference being 1⅝. Willans & Robinson Ordinary are 2½, the Preference 3½, and the 4 per cent. Debenture stock 77½. Brush Ordinary weakened ¼ to 10s. middle.

At 8 Anglo-American Telegraph Deferred is ½ better, making 15s. improvement in a fortnight, and the Ordinary stock has advanced a point to 48½. The animation in the Yankee market still continues to be a Stock Exchange feature, although the public on both sides of the water are really doing very little. Eastern Extension Preference regained its point fall of last week, and the Ordinary issues of the Eastern companies retain their advances. Western Telegraph 4 per cent. Debenture has risen 1 to 101½, and a similar rise in West India and Panama 5 per cent. Debentures brings the bonds to a similar price. Telephone varieties are unaltered on the week.

Traction properties are somewhat inactive. Anglo-Argentine Trams Ordinary and Preference continue to find supporters at 6¼ and 5½ respectively, and Auckland Debenture changed hands at par last Tuesday. Metropolitan Electric Trams 4½ per cent. Debenture is still a point below par, and a few orders came into the market in British Electric Traction Second Debenture, the price being about 95½. The stock carries 4½ per cent. interest.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1901. | 1902. | 1903. | Closing Quotations Aug. 24th. | Closing Quotations Aug. 31st. | Business done week ended Aug. 31st, 1904. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 67,100 | African Direct Telegraph, 4 % Debs. | 100 | .. | .. | .. | 97 —101 | 97 —101 | .. | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | .. | .. | .. | 2⅛ — 3⅛ | 2⅛ — 3⅛ | .. | .. |
| 119,700£ | Do. do. 5 % Debs., Nos. 1 to 1,350 Red. | 100 | .. | .. | .. | .. — .. | .. — .. | .. | .. |
| 788,940 | Anglo-American Telegraph | Stock | 61s. | 60/6 | 61s. | 46 — 49 | 47 — 50 | 48 | 47½ |
| 3,105,580 | Do. do. do. 6 % Pref. | Stock | 6 % | 6 % | 6 % | 90 — 92 | 90 — 92 | 92 | 91⅛ |
| 3,105,580 | Do. do. do. Deferred | Stock | 2s. | 1/- | 2s. | 7½ — 7⅞ | 7⅞ — 8⅛ | 8⅛ | 7⅞ |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 5 % | 6 % | 7 % | 5 — 5½ | 5 — 5½ | 5⅛ | 5¼ |
| 18,888,800$ | Commercial Cable | $100 | 8 % | 8 % | .. | 170 —190 | 170 —190 | .. | .. |
| 1,841,209 | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | .. | .. | .. | 94 — 96 | 94 — 96 | 95¼ | 94½ |
| 16,000 | Cuba Telegraph | 10 | 4 % | 6½ % | 5 % | 7 — 8 | 7 — 8 | .. | .. |
| 6,000 | Do. 10 % Pref. | 10 | .. | .. | .. | 15 — 16 | 15 — 16 | .. | .. |
| 12,931 | Direct Spanish Telegraph | .. | .. | .. | .. | .. — .. | .. — .. | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | .. | .. | .. | 7 — 8 | 7 — 8 | .. | .. |
| 80,000 | Do. do. 4½ % Debs. | 50 | .. | .. | .. | 98 —101 % | 98 —101% | .. | .. |
| 60,710£ | Direct United States Cable | 20 | 3½% | 3½% | 3 % | 10 — 10½ | 10 — 10⅜ | .. | .. |
| 81,800 | Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 99 —101 | 99 —101 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 7 % | 7 % | 7 % | 126 —131 | 126 —131 | 129 | 128 |
| 1,955,565 | Do. 3½ % Pref. Stock | 100 | .. | .. | .. | 86 — 89 | 87 — 90 | 89 | 88½ |
| 1,534,645 | Do. 4 % Mort. Deb. Stock Red. | Stock | .. | .. | .. | 105 —108 | 105 —108 | .. | .. |
| 800,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | 7 % | 12 — 12½ | 12 — 12½ | 12½ | 12⅛ |
| 830,000£ | Do. 4 % Deb. Stock | Stock | .. | .. | .. | 103 —106 | 103 —106 | .. | .. |
| 800,000 | Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 200,000£ | Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | .. | .. | .. | 100 —103 | 100 —103 | 101 | .. |
| 180,227 | Globe Telegraph and Trust | 10 | 5½% | £3 16 7* | 5½% | 8⅞ — 9⅛ | 8⅞ — 9⅛ | 9⅛ | 8⅞ |
| 180,042 | Do. do. 6 % Pref. | 10 | .. | .. | .. | 13¾ — 14 | 13¾ — 14 | 13⅞ | 13⅝ |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 15 % | 12½% | 15 % | 25½ — 26½ | 26½ — 26½ | .. | .. |
| 54,700 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 99 —101 | 99 —101 | .. | .. |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10% | 10 % | 43 — 46 | 43 — 46 | .. | .. |
| 1,968,333 | National Telephone, Pref. Stock | 100 | 5 % | 6 % | 6 % | 104 —106 | 104 —106 | 105¼ | 104½ |
| 1,966,667 | Do. do. Def. Stock | 100 | .. | 4½% | 5 % | 89 — 92 | 89 — 92 | 90½ | 89½ |
| 15,000 | Do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 12 — 14 | 12 — 14 | 13 | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 11 — 13 | 11 — 13 | .. | .. |
| 2,250,000 | Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5½ — 5⅝ | 5½ — 5⅝ | 5⅝ | .. |
| 000,000£ | Do. do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 3½% | 97 — 99 | 97 — 99 | .. | .. |
| 689,593 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 104 —106 | 104 —106 | .. | .. |
| 1,000,000 | Do. do. Prov. Certs., 85 % to be paid | .. | .. | .. | .. | 65 — 67 | 65 — 67 | 66⅞ | 66½ |
| 179,313 | Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid | 1 | 6 % | 6 % | 6½% | ⅞ — 1 1/16 | ⅞ — 1 1/16 | .. | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. | 1 | .. | .. | .. | 1 — 1⅛ | 1 — 1⅛ | .. | .. |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 11,889 | Reuter's | 8 | 5 % | 5 % | .. | 6½ — 7½ | 6½ — 7½ | .. | .. |
| 3,808 | Submarine Cables Trust | Cert. | .. | .. | .. | 118 —123 | 118 —123 | .. | .. |
| 88,000 | United River Plate Telephone | 5 | 7 % | 7 % | .. | 6 — 6½ | 6 — 6½ | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | .. | .. | .. | 4½ — 5½ | 4½ — 5½ | 5 | .. |
| 179,947£ | Do. do. 5 % Debs. | Stock | .. | .. | .. | 103 —106 | 103 —106 | .. | .. |
| 15,600 | West African Telegraph, Shares | 10 | .. | 2 % | 4 % | 6 — 7 | 6 — 7 | .. | .. |
| 150,000£ | West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel. | 100 | .. | .. | .. | 97 — 100 | 97 —100 | .. | .. |
| 207,980 | Western Telegraph, Ltd., Nos. 1 to 207,980 | 10 | 7 % | 7 % | 7 % | 12 — 12½ | 12 — 12½ | 12½ | .. |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 400,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 99 —102 | 100 —103 | 101¾ | 101 |
| 88,231 | West India and Panama Telegraph | 10 | .. | .. | .. | ⅜ — ½ | ⅜ — ½ | .. | .. |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | .. | .. | .. | 6⅛ — 6¼ | 6¼ — 6¼ | .. | .. |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | .. | .. | .. | 5 — 6 | 5 — 6 | 6¼ | 5 |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | .. | .. | .. | 99 —102 | 100 —103 | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | British Aluminium ¶ % Cum. Pref. | 10 | .. | .. | .. | 5 — 6 | 5 — 6 | .. | .. |
| 800,000£ | Do. do. 5 % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 92 — 97 | 92 — 97 | .. | .. |
| 100,000 | British Electric Traction | 10 | 9 % | 8 % | .. | 8⅞ — 9⅛ | 8⅞ — 9⅛ | 9⅛ | .. |
| 100,000 | Do. do. 6 % Cum. Pref. | 10 | .. | .. | .. | 10½ — 11 xd | 10½ — 11 | 10⅝ | 10⅜ |
| 600,000£ | Do. do. 5 % Perpetual Debenture Stock | Stock | .. | .. | .. | 116 —119 | 116 —119 | .. | .. |
| | Do. do. 4½% 2nd Deb. Stock Red. | 100 | .. | .. | .. | 94 — 97 | .. — .. | 95½ | .. |
| 100,000 | British Insulated and Helsby Cables | 5 | 10 % | 10 % | 8 % | 5⅞ — 6⅛ | 5⅞ — 6⅛ | .. | .. |
| 100,000 | Do. do. 6 % Cum. Pref. | 5 | .. | .. | .. | 5½ — 6 | 5½ — 6 | 5⅝ | .. |
| 50,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 50,000 | ¶Browett, Lindley & Co., Ord. | £1 | Nil | .. | .. | 1/16 — 1/8 | 1/16 — 1/8 | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. | £1 | 6 % | .. | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. |
| 105,781 | Brush Electrical Engineering, Ord., 1 to 105,781 | 2 | Nil | Nil | Nil | ½ — 1 | ½ — ¾ | .. | .. |
| 150,000 | Do. do. Non-cum. 6 % Pref. | 2 | 3 % | 6 % | 6 % | 1 — 1½ | 1 — 1½ | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock | Stock | .. | .. | .. | 96 — 99 | 94 — 97 xd | .. | .. |
| *25,000£ | Do. do. 4½ % Perp. 2nd Deb. Stock | Stock | .. | .. | .. | 70 — 75 | 70 — 75 | .. | .. |
| 35,000 | Callender's Cable Construction shares | 5 | 20 % | 15 % | 12½% | 9¾ — 10⅛ | 9¾ — 10⅛ | .. | .. |
| 40,000 | Do. do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 5 — 5⅛ | 5 — 5⅛ | .. | .. |
| 90,000£ | Do. do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 101 —105 | 101 —105 | 102½ | .. |
| 1,860,014 | Central London Railway, Ord. Stock | Stock | 4 % | 4 % | 4 % | 87 — 89 xd | 87 — 89 | 89 | 87 |
| 494,998 | Do. do. 4 % Pref. Stock | Stock | 4 % | 4 % | 4 % | 100 —102 xd | 100 —102 | .. | .. |
| 494,998 | Do. do. Def. do. | Stock | 4 % | 4 % | 4 % | 80 — 82 | 80 — 82 | 81 | .. |
| 1,880,000 | City and South London Railway | Stock | 2 % | 3½% | 2⅝% | 44 — 46 | 40 — 42 | 41½ | 41½ |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 5 | 7½% | 5 % | .. | 1¾ — 2 xd | 1¾ — 2 | .. | .. |
| 100,000£ | Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red. | .. | .. | .. | .. | 94 — 97 | 90 — 95 | 92 | .. |
| 99,261 | Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261 | 5 | Nil | Nil | .. | ½ — ¾ | ½ — ¾ | .. | .. |
| 17,139 | Do. do. "A" shares, 01—017,139 | 5 | Nil | Nil | .. | 1 — 2 | 1 — 2 | .. | .. |
| 44,028£ | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 77 — 82 | 77 — 82 | .. | .. |
| 100,000£ | Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd. | 100 | .. | .. | .. | 79 — 83 | 79 — 83 | .. | .. |
| 12,100 | Electric Construction 1 to 112,100 | 2 | 6 % | 6 % | 4 % | 1 — 1½ | 1 — 1½ | .. | .. |
| 81,890 | Do. do. 7 % Cum. Pref., 1 to 81,890 | 2 | .. | .. | .. | 2 — 2½ | 2 — 2½ | .. | .. |
| 82,500£ | Do. do. 4 % Perp. 1st Mort. Deb. Stock | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 5 % | 5 % | .. | 9 — 9⅛ | 9 — 9⅛ | .. | .. |
| 300,000 | Do. do. 4 % Mort. Deb. | Stock | .. | .. | .. | 93 — 98 | 93 — 98 | .. | .. |
| 200,000 | Henley's (W. T.) Telegraph Works, Ord. | 5 | 20 % | 20 % | 15 % | 11 — 12 | 11 — 12 | 11¼ | 11 |
| 200,000 | Do. do. 4½ % Pref. | 5 | .. | .. | .. | 5 — 5⅛ | 5 — 5⅛ xd | 5 3/32 | .. |
| 45,900 | Do. do. 4½ Mort. Deb. Stock | Stock | .. | .. | .. | 107 —111 | 107 —111 xd | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works | 10 | 10 % | 10 % | .. | 18½ — 19½ | 18½ — 19½ | 19½ | 19⅛ |
| 800,000£ | Do. do. do. 4 % 1st Mort. Deb. | 100 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 87,500 | †Liverpool Overhead Railway, Ord. | 10 | 1½% | 1½% | .. | 3 1/16 — 3 1/8 | 3 1/16 — 3 1/8 | .. | .. |
| 10,000 | † Do. do. Pref. £10 paid | 10 | .. | .. | .. | 9⅜ — 10⅛ | 10 — 10⅜ | .. | .. |
| 87,350 | Telegraph Construction and Maintenance | 12 | 20 % | 20 % | 20 % | 35 — 38 | 35 — 38 | 35 | .. |
| 150,000£ | Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909 | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 540,000£ | Waterloo & City Railway, Ord. Stock | 100 | 3 % | 3½% | 3½% | 86 — 89 xd | 86 — 89 | 86 | .. |

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

## SHARE LIST OF ELECTRICAL COMPANIES (continued).— ELECTRICITY SUPPLY COMPANIES.

| Present issue. | NAME, | Stock or Share. | Dividends for the last three years 1901. | 1902. | 1903. | Closing Quotations Aug. 24th. | Closing Quotations Aug. 31st. | Business done week ended Aug. 31st, 1904. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 .. | £ | 8¾% | 8 % | 10 % | 10⅞— 11½ xd | 10⅞— 11½ | .. | .. |
| 20,000 | Do. do. 7 % Cum. Pref. .. | £ | .. | .. | .. | 10¼— 10⅝ xd | 10½— 10⅝ | 10⅞ | .. |
| 250,000 | Central Electric Supply 4 % Guar. Deb. Stock .. .. .. | 100 | .. | .. | .. | 106 —109 | 106 —109 | .. | .. |
| 50,000 | Charing Cross and Strand Electricity Supply .. .. .. | £ | 10 % | 10 % | 8 % | 7½— 8 xd | 7⅜— 8⅛ | 8 | 7⅞ |
| 70,000 | Do. do. do. 4½% Cum. Pref. .. | £ | .. | .. | .. | 5⅛— 5⅜ xd | 5⅛— 5⅜ | 5⅛ | 5⅛ |
| 40,000 | Do. do. "City Undertaking" 4½% Cum. Pref. .. | £ | .. | .. | .. | 4⅜— 5 | 4⅜— 5 | .. | .. |
| 40,000 | Do. do. 1903 .. .. .. .. .. | £ | .. | .. | .. | 4⅜— 5 | 4⅜— 5 | 4⅜ | .. |
| 250,000 | Do. do. 4 % Deb. Stock Red. .. .. .. | 100 | .. | .. | .. | 102 —104 | 102 —104 | .. | .. |
| 44,486 | *Chelsea Electricity Supply, Ord. .. .. .. .. .. | £ | 4 % | 4½% | 5¼% | 6½— 7 | 6¾— 7 | 6⅞ | 6⅞ |
| 150,000£ | Do. do. % Deb. Stock Red. .. .. .. | Stock | .. | .. | .. | 106 —109 | 106 —109 | .. | .. |
| 70,595 | City of London Electric Lighting, Ord. 40,001—110,595 .. | £ | 5 % | 5 % | 5 % | 10¼— 10¾ | 10¼— 10¾ | 10⅜ | 10½ |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 .. .. .. .. | £ | .. | .. | .. | 13 — 14 | 13 — 14 | .. | .. |
| 400,000£ | Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid .. | 100 | .. | .. | .. | 120 —125 | 120 —125 | .. | .. |
| 800,000 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid .. .. | 100 | .. | .. | .. | 102 —105 | 102 —105 | 103 | .. |
| 40,000 | County of London Electric Lighting, Ord. 1—40,000 .. .. | £ | 4 % | 4 % | 4 % | 7½— 8½ xd | 7½— 8½ | 8⅛ | 8⅛ |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000.. | £ | .. | .. | .. | 11 — 12 xd | 11 — 12 | .. | .. |
| 400,000£ | Do. do. 4½% Deb. Stock .. .. .. .. .. | 100 | .. | .. | .. | 105 —108 | 105 —108 | .. | .. |
| 250,000 | Do. do. 4½% 2nd Deb. Stock .. .. .. .. | Stock | .. | .. | .. | 101 —104 | 101 —104 | 101⅜ | 101½ |
| 50,000 | Edmundson's Electric Corporation, Ord. Shares .. .. | £ | 7 % | 7 % | 7 % | 6 — 6½ | 6 — 6½ | 6¼ | 6⅛ |
| 80,000 | Do. do. 6 % Cum. Pref. .. .. .. .. | £ | .. | .. | .. | 6 — 6½ | 6 — 6¼ | 6⅛ | 6⅛ |
| 140,000 | Do. do. 4½% 1st Mort. Deb. Stock .. | 100 | .. | .. | .. | 104 —107 | 104 —107 | .. | .. |
| 21,000 | Kensington and Knightsbridge Electric Ord. .. .. .. .. | £ | 10 % | 10 % | 12% | 12 — 13 | 12 — 13 | .. | .. |
| 90,000 | Do. do. do. 4 % Debenture Stock .. | Stock | .. | .. | .. | 102 —105 | 102 —105 | .. | .. |
| 110,000 | London Electric Supply Corporation, Limited, Ord. .. .. | £ | .. | .. | .. | 1½— 1⅝ | 1½— 2 | .. | .. |
| 49,840 | Do. do. do. 6 % Pref. .. .. | £ | .. | .. | .. | 5 — 5½ | 5 — 5½ xd | 5⅛ | .. |
| 250,000£ | Do. do. do. 4 % 1st Mort. Deb. Stock Red | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 100,000 | Metropolitan Electric Supply, 1 to 100,000 .. .. .. .. | £ | 6½% | 7½% | 8½% | 15¼— 16½ xd | 15¼— 16½ | 16⅛ | 16⅛ |
| 71,106 | Do. do. 4½% Cum. Pref. 1—71,106, £3 paid .. | £ | .. | .. | .. | 5⅛— 5⅜ | 5⅛— 5⅜ | 5⅜ | 5⅜ |
| 220,000£ | Do. do. 4½% 1st Mort. Deb. Stock .. .. | .. | .. | .. | .. | 109 —113 | 109 —113 | .. | .. |
| 250,000£ | Do. do. 3½% Mort. Deb. Stock Red .. .. | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 10,852 | Notting Hill Electric Lighting .. .. .. .. .. | £ | 6 % | 6 % | 6 % | 14 — 15 | 14 — 15 | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. .. .. .. | £ | 14½% | 14½% | 14½% | 14 — 15 | 14½— 15½ | 14⅞ | 14⅞ |
| 20,000 | Do. do. do. 7 % Pref. 20,081 to 40,080 | £ | .. | .. | .. | 8 — 9 | 8 — 9 | .. | .. |
| 150,000£ | Do. do. do. 3½% Deb. Stock Red .. | 100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. .. .. .. .. | £ | .. | 2½% | 4 % | 2⅜— 3½ | 2⅜— 3½ | 2⅝ | .. |
| 50,000 | Do. do. do. 4 % Deb. Stock .. .. | Stock | .. | .. | .. | 83 — 88 | 83 — 88 | .. | .. |
| 65,000 | South London Electricity Supply, Ord. .. .. .. .. | £ | .. | 1½% | 3 % | 3⅜— 4¼ | 3⅜— 4¼ | 4⅜ | .. |
| 100,000 | South Metropolitan Electric Light and Power, Ord. .. .. | £ | .. | .. | .. | ⅞— 1 | ⅞— 1 | .. | .. |
| 50,000 | Do. 7 % Pref. .. .. .. .. .. | £ | .. | .. | .. | 1⅛— 1⅜ | 1⅛— 1⅜ xd | .. | .. |
| 100,000 | Do. 4½% 1st Deb. Stock .. .. .. .. | 100 | .. | .. | .. | 103 —107 | 103 —107 | .. | .. |
| 80,000 | Urban Electric Supply, Ord. .. .. .. .. .. | £ | .. | .. | .. | 4⅛— 5 | 4⅜— 4⅝ | 4⅞ | .. |
| 80,000 | Do. do. 5 % Cum. Pref. .. .. .. .. | £ | .. | .. | .. | 4⅞— 5⅛ | 4⅞— 5⅛ | .. | .. |
| 110,000 | Westminster Electric Supply, Ord. .. .. .. .. | £ | 10½% | 12 % | 13½% | 12½— 13½ | 12½— 13½ | 12⅝ | 12⅝ |
| 28,141 | Do. do. 5 % Cum. Pref. .. .. .. .. | £ | .. | .. | .. | 6 — 6½ | 6 — 6½ | 6⅛ | .. |

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

## MARKET QUOTATIONS, Wednesday, September 2nd.

| CHEMICALS, &c. | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|
| a Acid, Hydrochloric .. .. .. | per cwt. | 5/- | .. |
| a ,, Nitric .. .. .. .. | per cwt. | 22/- | .. |
| a ,, Oxalic .. .. .. .. | per cwt. | 32/- | .. |
| a ,, Sulphuric .. .. .. .. | per cwt. | 5/6 | .. |
| a Ammoniac, Sal .. .. .. | per cwt. | 42/- | .. |
| a Ammonia, Muriate (crystal) .. | per ton | £33 10 | .. |
| a ,, ,, .. .. .. | per ton | £30 | .. |
| a Bleaching powder .. .. .. | per ton | £4 10 | .. |
| a Bisulphide of Carbon .. .. | per ton | £15 | .. |
| a Borax .. .. .. .. .. | per ton | £13 | .. |
| a Benzole (90 %) .. .. .. | per gal. | 7/- | .. |
| a ,, (50/90 %) .. .. .. | per gal. | 5/6 | .. |
| a Copper Sulphate .. .. .. | per ton | £19 | .. |
| a Lead, Nitrate .. .. .. | per ton | £30 | .. |
| a ,, White Sugar .. .. .. | per ton | £31 | .. |
| a ,, Peroxide .. .. .. .. | per ton | £27 10 | .. |
| a Methylated Spirit .. .. .. | per gal. | 2/6 | .. |
| a Naphtha, Solvent (90% a 160° C). | per gal. | 5/6 | .. |
| a Potash, Bichromate, in casks .. | per lb. | 8d. | .. |
| a ,, Caustic (75/80%).. .. | per ton | £24 | .. |
| a Shellac .. .. .. .. .. | per cwt. | 210/- | .. |
| a Sulphate of Magnesia .. .. | per ton | £4 10 | .. |
| a Sulphur, Sublimed Flowers .. | per ton | £6 10 | .. |
| a ,, Recovered .. .. .. | per ton | £5 10 | .. |
| a ,, Lump .. .. .. .. | per ton | £5 .. | .. |
| a Soda, Caustic (white 70 %) .. | per ton | £10 15 | .. |
| a ,, Crystals .. .. .. | per ton | £8 .. | .. |
| a ,, Bichromate, casks.. .. | per lb. | 2½d. | .. |

| METALS, &c. | | | |
|---|---|---|---|
| b Aluminium Ingots, in ton lots .. | per ton | £130 | .. |
| b ,, Wire, in ton lots .. | per ton | £168 | .. |
| b ,, Sheet, in ton lots .. | per ton | £166 | .. |
| b Babbitt's metal ingots .. .. | per ton | £48 to £130 | .. |
| c Brass (rolled metal 2" to 12") basis | per lb. | 6¾d. | .. |
| c ,, Tube (brazed) .. .. | per lb. | 8¼d. | .. |
| c ,, ,, (solid drawn).. .. | per lb. | 7¼d. | .. |
| c ,, Wire, basis.. .. .. | per lb. | 6¾d. | .. |
| c Copper Tubes (brazed) .. .. | per lb. | 9¼d. | .. |
| c ,, ,, (solid drawn) .. | per lb. | 9¼d. | .. |
| c Copper Bars (best selected .. | per ton | £70 | .. |

| METALS, &c. (continued). | | Latest Price. | Week's Dec. or Inc. |
|---|---|---|---|
| g Copper Sheet .. .. .. | per ton | £70 | .. |
| g ,, Rod .. .. .. .. | per ton | £70 | .. |
| e ,, (Electrolytic) Bars .. | per ton | £62 | .. |
| e ,, ,, Sheets .. | per ton | £78 | .. |
| e ,, ,, Rod .. | per ton | £72 | .. |
| e ,, ,, H.C. Wire | per lb. | 7¾d. | .. |
| f Ebonite Rod .. .. .. | per lb. | 3/8 | .. |
| f ,, Sheet .. .. .. | per lb. | 8/- | .. |
| n German Silver Wire .. .. | per lb. | 1/6 | .. |
| h Gutta-percha fine .. .. .. | per lb. | 8/- | .. |
| h India-rubber, Para fine .. .. | per lb. | 4/11 to 5/- | dec. |
| i Iron, Charcoal Sheets .. .. | per ton | £18 | .. |
| i ,, Pig (Cleveland warrants) | per ton | 42/0 | 2d. dec. |
| i ,, Forgings, according to size | per ton | From £11 | .. |
| i ,, Scrap, heavy .. .. | per ton | 47/6 to 50/- | .. |
| i ,, Wire, galvanised No. 8 .. | per ton | £9 15 | .. |
| g Lead, English Ingot .. .. | per ton | £12 | 2/6 dec. |
| g ,, ,, Sheet .. .. | per ton | £11 17s. 6d. | .. |
| m Manganin Wire No. 28 .. .. | per lb. | 8/- | .. |
| g Mercury .. .. .. .. | per bot. | £7 15 | .. |
| d Mica (in original cases) small .. | per lb. | 6d. to 1/ | .. |
| d ,, ,, ,, medium | per lb. | 2/6 to 4/- | .. |
| d ,, ,, ,, large .. | per lb. | 4/6 to 8/6 | .. |
| p Phosphor Bronze, plain castings | per lb. | 1/- to 1/3½ | .. |
| p ,, rolled bars & rods | per lb. | 1/- to 1/8 | .. |
| p ,, ,, strip & sheet | per lb. | From 1/1 | .. |
| o Platinum .. .. .. .. | per oz. | £4 | .. |
| e Silicium Bronze Wire .. .. | per lb. | 9d. to 11d. | .. |
| i Steel, Magnet, acc'd'g to desc'p'n | per ton | £50 | .. |
| i ,, ,, in bars .. .. | | £15 to £40 | .. |
| g Tin, Block .. .. .. .. | per ton | £125 10 to £126 10 | 30/- inc. |
| g ,, Foil .. .. .. .. | per lb. | 1/6 | .. |
| n ,, Wire, Nos. 1 to 16 .. .. | per lb. | 1/7 | .. |
| p White Anti-friction Metals— "White Ant" brand .. | per ton | £42 to £62 | .. |
| j Yarns, 2/10s Grey Cotton, on sp'ls | per lb. | 8d. | .. |
| j ,, 6 lea. Flax .. .. .. | per lb. | 5¾d. | .. |
| j ,, 3 ply 10 lbs. Russian .. | per lb. | 4½d. | .. |
| j ,, 10 lbs. Russian, single .. | per lb. | 4½d. | .. |
| j ,, 180 lbs. Jute rove .. | per ton | £11 | .. |
| k Zinc, Sh't (Vieille Montagne brd.) | per ton | £25 5 | .. |

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| Locality. | Week ending | Receipts for the week. £ | £* | No. wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|
| Aberdeen .. .. | Aug. 20 | 1,825 | +292 | 12 | 12,669 | + 3,694 | 10 | — |
| Bath .. .. .. | ,, 24 | 771 | — | 35 | 21,482 | — | 12½ | — |
| Birmingham .. .. | ,, 27 | 4,870 | —168 | 35 | 168,084 | +11,402 | 3½ | — |
| Blackburn .. .. | ,, 19 | 789 | —102 | 21 | 20,549 | + 1,860 | 13½ | — |
| Blackpool .. .. | ,, 25 | 2,822 | +888 | 21 | 28,661 | + 3,489 | 8½ | — |
| ,, —Fleetw'd | ,, 27 | 1,852 | +416 | 8 | 12,582 | — 136 | 7½ | — |
| ,, —Lytham | ,, 25 | 1,157 | + 370 | 43 | 15,843 | + 6,646 | 7½ | — |
| Bolton .. .. | ,, 28 | 2,095 | +360 | 22 | 41,803 | + 343 | 25 | — |
| Bournemouth .. .. | ,, 24 | 1,497 | + 58 | 21 | 25,112 | — | 10½ | — |
| Bradford .. .. | ,, 20 | 4,951 | +829 | 20 | 96,864 | +17,026 | 50 | — |
| Brighton .. .. | ,, 28 | 1,375 | +283 | — | 23,902 | — | 9 | — |
| Bristol .. .. | ,, 26 | 4,981 | — 49 | — | — | — | 28 | — |
| Devonport .. .. | ,, 19 | 599 | +120 | 33 | 17,680 | + 2,891 | 5 | — |
| Dudley—Sto'rb'ge | ,, 19 | 964 | + 72 | 33 | 28,811 | + 1,198 | 18½ | — |
| Gateshead .. | ,, 19 | 968 | + 52 | 33 | 29,933 | + 1,373 | 10½ | + ½ |
| Gr'n'k—Pt. Glsgw | ,, 19 | 688 | — 22 | 33 | 18,920 | + 952 | 7½ | — |
| Oldham—Ashton | ,, 19 | 684 | — 20 | 33 | 18,120 | — 977 | 8 | — |
| Potteries .. .. | ,, 19 | 1,472 | + 13 | 33 | 56,274 | + 4,922 | 28½ | — |
| South Staffs. .. | ,, 19 | 711 | —337 | 33 | 25,584 | — 3,558 | 21½ | — |
| Swansea .. .. | ,, 19 | 617 | + 19 | 33 | 18,298 | + 1,003 | 5½ | — |
| Wolverhampton.. | ,, 19 | 414 | + 17 | 33 | 12,968 | — 88 | 10½ | +8 |
| Yorks. Wool Dist. | ,, 19 | 632 | +153 | 33 | 19,840 | + 8,007 | 6 | — |
| Miscellaneous .. | ,, 19 | 4,450 | — | 33 | 107,918 | — | — | — |
| Burnley .. .. | ,, 27 | 1,053 | +183 | — | — | — | 10½ | +3½ |
| Burton-on-Trent .. | ,, 28 | 434 | + 75 | 22½ | 7,970 | — | 8½ | — |
| Cardiff .. .. | ,, 20 | 2,189 | +101 | 20 | 43,465 | + 1,876 | 14 | — |
| Chatham & District | ,, 25 | 672 | + 9 | 34 | 20,198 | + 2,230 | 9½ | — |
| Cork .. .. .. | ,, 25 | 490 | —180 | 34 | 15,885 | — 2,057 | 9·89 | — |
| Dover .. .. | ,, 27 | 295 | + 7 | 34 | 7,526 | — 293 | 8 | — |

* Compared with the corresponding period of 1903.

| Locality. | Week ending | Receipts for the week. £ | £* | No. wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|
| Dublin .. .. | Aug. 26 | 6,382 | + 285 | — | 46,255 | — 2,943 | 47 | + ½ |
| East Ham .. .. | ,, 27 | 759 | + 25 | 21 | 16,689 | + 1,983 | 5 | + ½ |
| Glasgow .. .. | ,, 27 | 13,982 | +198 | 14 | 180,743 | +11,108 | 71½ | +0½ |
| Halifax (2 weeks) .. | ,, 24 | 3,258 | +174 | 21 | 33,655 | + 2,460 | 33 | +1½ |
| Huddersfield .. | ,, 27 | 1,264 | + 34 | 21 | — | — | 28 | — |
| Hull .. .. | ,, 27 | 2,155 | +341 | 21 | 46,426 | + 6,199 | 13 | +2½ |
| Ilkeston .. .. | ,, 26 | 150 | — 34 | 21 | 3,178 | — | 3·5 | — |
| Ipswich .. .. | ,, 27 | 618 | — | 21 | 11,536 | — | 10½ | — |
| Isle of Thanet .. | ,, 27 | 1,912 | + 241 | 31 | 24,973 | + 1,024 | 10½ | — |
| Leeds .. .. | ,, 27 | 5,577 | + 85 | — | 131,347 | + 7,815 | 81½ | +2 |
| Liverpool .. .. | ,, 20 | 10,441 | — 82 | 34 | 351,458 | +11,774 | 103 | — |
| London C. C. .. | ,, 20 | 13,429 | +2941 | 20 | 257,074 | +51,813 | 46½ | +6½ |
| Manchester .. .. | ,, 27 | 12,485 | +804 | 21 | 263,797 | +10,377 | 137½ | +12½ |
| Newcastle .. .. | ,, 27 | 3,584 | + 74 | — | — | — | 17 | — |
| Portsmouth .. .. | ,, 27 | 2,573 | + 200 | — | 47,053 | + 4,188 | 14½ | — |
| Salford .. .. | ,, 22 | 3,926 | + 70 | — | 85,778 | + 6,309 | 30 | — |
| Sheffield .. .. | ,, 28 | 4,647 | +258 | 22 | 105,196 | + 2,568 | 33 | +6½ |
| Southampton .. .. | ,, 11 | 1,145 | —125 | — | — | — | 9 | — |
| Southend-on-Sea .. | ,, 24 | 633 | +101 | 21 | 8,908 | + 1,065 | 6½ | — |
| Sunderland .. .. | ,, 28 | 1,446 | +211 | 21 | 28,894 | + 713 | 21 | +1 |
| Tyneside .. .. | ,, 17 | 408 | — 32 | 33 | 12,711 | + 2,072 | 8·9 | +·4 |
| West Ham .. .. | ,, 25 | 1,147 | — | 26 | 22,667 | — | 8·62 | — |
| Wolverhampton .. | ,, 24 | 748 | +282 | — | — | — | 9·5 | — |
| Cen. London Rly. .. | ,, 27 | 5,480 | — 19 | 8 | 46,580 | — 2,066 | 6 | — |
| City & S. Lon. Rly. | ,, 28 | 2,257 | —146 | 9 | 20,767 | — 1,091 | 6½ | — |
| Dublin—Lucan Rly. | ,, 26 | 141 | + 2 | 8 | 1,300 | + 32 | 6½ | — |
| G. N. and City Ry. | ,, 27 | 1,010 | — | 28 | 26,314 | — | 3½ | — |
| L'pool Overh'd Rly. | ,, 28 | 1,638 | + 12 | 9 | 15,369 | — 151 | 6½ | +42 |
| Mersey Railway .. | ,, 27 | 1,125 | +118 | 8 | 11,516 | + 698 | 4½ | — |

# THE BRITISH ASSOCIATION, CAMBRIDGE, 1904.

## ELECTRICITY FROM WATER-POWER.

By A. A. Campbell Swinton.

*(Read before Section G, Monday, August 22nd.)*

It should be gratifying to our national pride to know that probably the very earliest example of the production of electricity by means of water-power on a practical scale, and its transmission to a distance, was the installation put up for the purpose of lighting at Cragside, Northumberland, by the late Lord Armstrong, in the year 1882. This plant, which was still in daily use in 1884, when the author saw it in operation, consisted of a Siemens continuous-current dynamo, which was driven by means of a belt off an 8-H.P. water-turbine operating with a fall of 30 ft., the electricity, which was delivered at 90 volts pressure, being carried by bare overhead wires attached to porcelain insulators on poles to the house, about a mile distant. It is an interesting fact that when the installation was first put to work, it was designed to operate with only a single wire, connection being made to the hydraulic power pipes at the one end and to the ordinary household water-pipes at the other, the earth being expected to form a sufficient return in the manner employed in telegraphy. This plan, which was adopted on the advice of the late Sir William Siemens, was found to be quite ineffective, as, owing to the low voltage employed, and the exceedingly rocky nature of the ground, no useful amount of electricity could be transmitted, until the earth return was done away with and a second metallic conductor substituted.

Though this 22-year-old English example of electricity developed by water power and transmitted to a distance was, as already mentioned, probably the first such installation in existence in the world, the great development of such installations has, up to recently, taken place almost exclusively abroad. No doubt, up and down this country a very considerable number of small electric plants operated by water power have been put up for private house lighting and such like purposes, and there are even towns—such as, for instance, Salisbury and Keswick—where water power has for long been employed to assist steam power for electrical production for public and private lighting, the water power being in these instances found of great value for the purpose, more especially of maintaining the supply during the periods of minimum load. A few hundred horse-power will, however, probably cover the whole of the plants of this character at present running in Great Britain, which is an altogether insignificant amount compared with the much larger corresponding figures for the continents of Europe, America, and other countries.

To obtain accurate statistics as to the amount of water horse-power at present employed for electrical production throughout the whole world is a very difficult matter, as in many countries no figures are available, while in others such as are obtainable are not up to date.

The following table, giving an aggregate horse-power of nearly 1½ millions, comprises all the hydraulic electricity works of which the author has been able to obtain particulars. He has, however, no doubt that there must be many others in existence to which he has not been able to find any reference; while again, in the case of a number of the installations which have been included, the horse-power now employed is greater than that in use at the time that the statistics were made out.

Water-Power Electricity Installations.

| | Horse-power. |
|---|---|
| United States of America ... ... ... | 527,467 |
| Canada ... ... ... ... ... ... | 228,225 |
| Mexico ... ... ... ... ... ... | 18,470 |
| Venezuela ... ... ... ... ... | 1,200 |
| Brazil ... ... ... ... ... ... | 800 |
| Japan ... ... ... ... ... ... | 3,450 |
| Switzerland ... ... ... ... ... | 133,302 |
| France ... ... ... ... ... ... | 161,343 |
| Germany ... ... ... ... ... | 81,077 |
| Austria ... ... ... ... ... ... | 16,000 |
| Sweden... ... ... ... ... ... | 71,000 |
| Russia ... ... ... ... ... ... | 10,000 |
| Italy ... ... ... ... ... ... | 210,000 |
| India ... ... ... ... ... ... | 7,050 |
| South Africa ... ... ... ... ... | 2,100 |
| Great Britain ... ... ... ... ... | 11,906 |
| Total horse-power ... ... | 1,483,390 |

It therefore seems reasonable to suppose that the total amount of water-power actually used for electrical production throughout the world at the present time must exceed 2,000,000 H.P., which is about double the total steam power at present devoted in Great Britain and Ireland to the same purpose.

It is interesting to calculate what would be the amount of coal required to produce this large amount of horse-power were it generated by steam engines in the ordinary way—in other words, what is the saving of coal that the adoption of this amount of hydraulic power entails. Many of the hydraulic plants, particularly those which are used for chemical processes, operate at full power continuously night and day, but others work for shorter hours. Assuming, however, that the whole 2,000,000 H.P. is in use for 12 hours per diem—in other words, is employed on the average with what engineers call a 50 per cent. load factor—and assuming, as is reasonable, that were the energy produced by means of coal, at least 3 lbs. of this fuel would be required on the average per horse-power-hour, we get 5·86 tons of coal per horse-power year, or 11,720,000 tons of coal saved annually on account of the 2,000,000 water horse-power utilised. Though this may appear a large figure, it amounts to less than 2 per cent. on the total output of coal in the world, which, on the average of the last five years, was 632,000,000 tons per annum. Assuming, however, an average cost of coal of 10s. per ton, this 11,720,000 tons represents £5,860,000 yearly, an amount which it would take over £100,000,000 of capital earning 5 per cent. per annum to provide.

Apart from mere magnitude, many of the more recent examples of hydro-electric engineering abroad, especially in America, are interesting by reason of the enormous distances over which the electric energy is being economically transmitted, and the very high electric pressures that in numerous cases are being successfully employed.

The longest distance over which transmission has so far been commercially effected is probably the 232 miles of line belonging to the California Gas and Electric Corporation, which stretches from the de Sabla power-house, *vid* Cordelia, to the town of Sausalito, which is situated on the opposite side of the Golden Gate Straits from the city of San Francisco. What this transmission means will be realised when it is stated that the distance covered is about equal to that which separates Cambridge from Newcastle-on-Tyne. The same Californian company also owns the Colegate and Oakland transmission line, which runs 142 miles from the Colegate power-house, where 14,000 H.P. is developed from a head of water of 702 ft.

Another very long line is that which reaches from the electric power-house *vid* Stockton and Mission San José to San Francisco, a distance of 147 miles, over which 10,000 H.P. is being delivered regularly. This line belongs to the Standard Electric Co., who have 217 miles of power line, with a capacity of 27,000 H.P. in operation. The voltages employed, as is to be expected having regard to the distances covered, are very high, ranging from 55,000 to 67,000 volts, 60,000 volts being apparently the standard figure for many recent installations, of which the following are some examples:—

Plants Recently Installed by the Stanley Electric Manufacturing Co., Pittsfield, Massachusetts.

| Name. | H.P. capacity. | Voltage. | Transmission distance. Miles. | Head of water. |
|---|---|---|---|---|
| Quanajuato Power and Electric Co., Mexico ... ... ... | 8,000 | 60,000 | 101 | 300 ft. |
| Washington Water Power Co., Spokane ... ... ... | 12,000 | 60,000 | 110 | 68 ft. |
| Kern River Power Co., Los Angeles, California ... ... | 16,000 | 67,500 | 110 | — |
| Pierce Co. ... ... ... ... | 26,000 | 55,000 | 40 | — |
| Mexican Light and Power Co., Mexico ... ... ... ... | — | 60,000 | 110 | 1,500 ft. |
| Winnipeg General Power Co. ... | 10,000 | 60,000 | 60 | 40 ft. |
| Canadian Niagara Power Co. ... | — | 60,000 | 93 | — |
| Electric Development Co., of Ontario ... ... ... ... | — | 60,000 | 93 | — |

For these particulars the author is indebted to Mr. C. C. Chesney, chief engineer of the Stanley Electric Manufacturing Co., who have recently installed these and numerous other similar plants.

Mention should also be made of the 50,000-H.P. and the 125,000-H.P. plants for the Canadian Niagara Power Co. and the Electrical Power Co. of Ontario, contracted for by the Canadian General Electric Co., both of which will employ pressures ranging up to 60,000 volts; while to pass to another quarter of the globe, the Cauvery Falls electric power scheme in India has now been at work for over two years, and transmits 5,000 H.P. to the Mysore gold mines, a distance of 92 miles, using a pressure of 35,000 volts.

Turning now to the British Isles, the only large-scale plant for the production of electricity by water power at present in operation in this country is the well-known installation of the British Aluminium Co. at Foyers. This installation, which was originally designed by the late Mr. Birch, and carried out by Mr. W. Vaux Graham, has been at work ever since the year 1896, and the whole of the power is employed for electro-chemical purposes on the spot. A small percentage of the power is utilised for the production of calcium carbide, but the bulk is, and in the near future the whole of the power will be, used for making aluminium. At present the gross horse-power of the plant is 7,000 H.P., but plant for a further 2,000 H.P. is at the present moment being installed, and will be working in about a month's time.

The water is derived from the River Foyers, which has a catchment area of upwards of 100 square miles. Storage is effected by means of two lakes, which have been joined together by the raising of dams and embankments, the result being a continuous lake of about 5½ miles long by about ½ mile in width. The storage thus obtained is sufficient to run the entire plant continuously day and night for about 50 days.

From the River Foyers the water is first passed through a tunnel 8½ ft. in diameter, cut through the solid rock, to the penstock chamber, from which the water is delivered by separate cast-iron pipes to the turbines, which are installed on the shore of Loch Ness, and into which the water is finally discharged, the available head of water being 350 ft.

The British Aluminium Co. have recently obtained Parliamentary powers for a further large water-power installation on Loch Levan. It is their intention to commence immediately the development of this scheme, which is capable of giving 17,000 gross horse-power. The reservoir is artificial, and will contain about 150 days' storage of the full power, the head of water at the turbines being 964 ft.

It is anticipated that the whole of this power will also be taken up in the manufacture of aluminium on the spot, no distant transmission being, at present, at any rate, contemplated.

Another interesting water-power scheme of considerable dimensions is at the present moment being developed in Wales by the North Wales Electric Power Co, who have obtained Parliamentary powers for this purpose. Their first installation is at present being erected under the superintendence of Messrs. Harper Bros., the company's engineers, and derives its power from Lake Llydaw, on Snowdon. This lake, into which runs the water from Lake Glaslyn, is about 1½ miles in length, and about a quarter to half a mile in width. Its area is 5½ million sq. ft., and it derives its water from a catchment area of about 1⅔ sq. miles, including the summit of Snowdon. Being in the track of the Atlantic depressions, this area has one of the heaviest rainfalls in Europe, amounting on the average to 180 in. per annum. In 1903 it reached the phenomenal figure of 250 in. The prevailing winds are from the sea, and the atmospheric moisture is driven up the sloping side of the mountain, and on being condensed at the summit is discharged in the form of rain or snow on the eastern side over Lakes Glaslyn and Llydaw. The fall of the year gives the wettest months, and it happens that the quantity running from the lakes in spring is averaged up by the snow melting on the sheltered eastern side.

By means of a dam, about 100 ft. in length, the level of the lake is to be raised 20 ft. The water will be drawn from the lake by means of a tunnel 600 ft. in length, at a point 30 ft. below the present level, or 50 ft. below the level when the dams are completed, with the result that there will be sufficient storage for meeting a 90 days' drought. The total fall utilised will be about 1,150 ft., and the total horse-power available, on the basis of a nine hours' working day, is calculated at 8,200. The first installation consists of two steel pipe lines and four 1,000-KW. sets, each consisting of a double tangential water-wheel coupled to a three-phase alternator giving 11,000 volts at 40 periods per second.

The company will develop the full horse-power of Lake Llydaw before proceeding further, but they have also acquired a further water power at Llyn Eigiao, in the Conway Valley, where a fall of 800 ft. is obtainable, and where it is calculated there will be nearly twice as much horse-power available as there is at Llyn Llydaw.

One of the first objects of the North Wales Electric Power Co., as soon as their installation is completed, will be to supply energy for the working of certain light railways which they control in the district. It is, however, in addition, intended to supply electric energy throughout a large area, comprising the whole of the counties of Carnarvon, Merioneth, and Anglesea, and also a portion of the county of Denbigh.

Three-phase currents are to be used, and the transmission lines will be of bare copper wires, ·324 in. in diameter, carried on insulators triangularly placed on wooden poles. A large proportion of the transmission lines will be carried along the track of the above-mentioned light railways. Lines are to be laid to the principal slate quarry districts of Nantlle, Llanberis, Penrhyn, and Festiniog, where a considerable demand for power exists. The distances from the power station to these places range from 6 to 12 miles.

The latest water-power electric scheme in the United Kingdom is that of the Scotch Water-Power Syndicate, who have by agreement obtained from Lord Breadalbane and the trustees of the Colquhoun estate of Luss important water-power concessions. These agreements have been negotiated by Mr. E. Ristori, who, it may be mentioned, was one of the original founders of the Falls of Foyers installation, while the engineering and electrical details have been worked out by Mr. William Vaux Graham and the author.

The first power that it is proposed to develop is one connected with Loch Sloy, which is situated some 5 miles north of Tarbet, on the side of Ben Vorlich, between Loch Long and Loch Lomond. Loch Sloy, which is situated some 757 ft. above Loch Lomond, which, in turn, is some 26 ft. above the sea level, is fed from a catchment area of about 3,801 acres, which includes one side of Ben Vorlich, which, with its 3,092 ft., is one of the highest mountains in Scotland. The district has the very heavy rainfall of some 74 in. per annum, of which it is calculated that 60 in. will be collectable.

A dam will be constructed at the eastern end of the loch, which will raise the height of the latter by some 60 ft. This will impound some 240,000,000 cb. ft. of water, capable, with a calculated net fall of 700 ft. to Loch Lomond, of maintaining some 6,000 E.H.P. on a 25 per cent. load factor for the maximum possible period of drought, which is calculated at 100 days.

From the loch the water will be taken in the first instance along an open conduit 3,650 yards in length, which will follow the contour line round Ben Vorlich till a point is reached almost immediately above the position where the power-house will be constructed on the shore of Loch Lomond, at a spot called Inveruglas. From the end of this conduit to the power-house, the water will be conveyed in steel pipes, the length of the pipe line being about 600 yards, and the height of fall 700 ft.

From the power house an overhead transmission line is to be constructed in duplicate for the purpose of conveying the electric energy to the industrial areas of the Vale of Leven and the Clyde, which comprise the towns of Dumbarton, Helensburgh, Renton, and Alexandria, and includes shipbuilding yards, engineering and dye works, calico printing works, and factories of various descriptions, many of which have already intimated their desire to be supplied. The transmission line, for which private wayleaves have been obtained throughout, will be overhead on poles, starting from the generating station at Inveruglas, and continuing across country for a distance of 22 miles to a sub-station which will be situated at Renton, about midway between Dumbarton and the foot of Loch Lomond, in the centre of the Vale of Leven industrial area. At this sub-station the voltage will be reduced from the 40,000 volts which it is proposed to employ for the long-distance overhead transmission, to some 6,000 to 10,000 volts, it being the intention that the distribution from the sub-station to the various works shall be underground. We get into rather populous areas here, and it was not thought that it would be safe to run the wires overhead.

The following are the efficiencies which it is calculated will be obtained :—

| | Full-load efficiency. |
|---|---|
| Open conduit... Pipe line ... Turbines ... | 75 per cent. |
| Three-phase generators | 94 " |
| Step-up transformers | 97 " |
| High-tension transmission line | 93 " |
| Step-down transformers | 97 " |
| Underground distribution (say, 6,000 volts average) | 95 " |
| Total efficiency | 58·6 per cent. |

This is on the assumption of the energy being delivered to customers at 6,000 volts. If, as is probable in most instances, it will be delivered at lower voltages, there will be a further transformation, the efficiency of which will be 95 per cent. in the case of transformation in pressure only, and 86 per cent. in the transformation of continuous current, making the total over-all efficiencies: 55·6 per cent. for three-phase current delivered, and 50·3 per cent. for continuous current delivered.

So soon as a market has been found for the total power procurable from Loch Sloy, it is intended to utilise a further water power —for which the rights have also been obtained—at Ardlui, about two miles further up Loch Lomond. This power is also fed by a small loch with an available fall of 800 ft, the horse-power obtainable being about half that available at Loch Sloy. The Scotch Water-Power Syndicate have, in addition, obtained the rights to still further water powers that exist further north on the Breadalbane estate, and these will be utilised as soon as the demand for power justifies the capital expense. It is because of these additional powers, which will considerably extend the length of the transmission, that it is proposed from the start to employ so high a pressure as 40,000 volts.

It is estimated that the total cost of the Loch Sloy scheme, including the transmission line and the distribution to the various factories, will not exceed £200,000, which, on a basis of 5,000 H.P. delivered, works out at about £40 per horse-power, everything included. Seeing that many of the existing electric generating stations worked by steam have cost almost this amount for land, buildings, and generating plant, this does not appear to be an excessive figure, and it may be pointed out as an interesting fact that the 20 miles of overhead transmission line only accounts for some £24,000, or about 12 per cent. of the total expenditure. This, coupled with the fact that the calculated loss on the transmission line at full load will only amount to about 7 per cent., and the step-up and step-down losses to another 6 per cent., making 13 per cent. in all, will give some idea of the extent to which the length of the transmission line is but a comparatively unimportant factor in schemes of this description. It may be pointed out, further, that the above-mentioned line loss of 7 per cent. is upon the basis of only one of the two duplicate transmission lines being in use. When both are employed the line loss will be reduced to 3½ per cent., and the total transmission loss at full load will be only a little over 10 per cent.

The main transmission will be on the three-phase system over two sets of three copper conductors, each about $\frac{3}{10}$ in. in diameter, the possibility of conveying as much as 5,000 H.P. over a distance as great as 22 miles with only 3½ per cent. loss by means of such comparatively small wires being, of course, due to the high pressure employed. Indeed, using pressure as high as 40,000 volts, when it is a matter of transmitting comparatively small amounts of power, as, for instance, the 600 H.P. or thereabouts that under the present scheme it is expected will be required for the supply of the town of Helensburgh, the interesting point arises that the minimum size of conductor allowable is limited, not by electrical conditions, but by considerations of mechanical strength.

On the main transmission line the conductors will be carried at a minimum height of 40 ft. from the ground, while at all crossings over roads they will be enclosed in a wire cage to meet the Board of Trade requirements for ensuring public safety.

The application of water power in the United Kingdom can, of course, never attain the dimensions that it has already reached in America and elsewhere; still, the above brief account of what is at present being done in Scotland and in Wales shows that there are possibilities even in this old country of which till recently but few were aware.

As regards the economies of electrical generation by water-power, no general rule can, of course, be enunciated, and every case must be dealt with on its merits, according to local circumstances. This, notwithstanding it is possible to give an indication of what is generally involved, having regard more especially to the fact that with water-power, as a rule, interest on capital plays a much greater part in determining the cost than do labour or upkeep.

Avoiding, on the one hand, small powers where the costs are likely to be abnormally high, and on the other very large powers such as we do not possess in this country, it may be taken generally that interest on capital, depreciation, upkeep, and working expenses in this country will amount to about 12 per cent. on the capital expenditure.

On this basis it is easy to see that to be economically sound the capital involved must not exceed 8½ times the annual price which can be got for the whole of the energy. For instance, if 5,000 H.P. is available for sale, and £6 can be got for each horse-power on the

average per annum, the capital involved must not exceed £52 per horse-power, or £260,000 in all.

To conclude, it has been said that the greatest benefactor to the human race is he who makes two blades of grass to sprout where only one grew before. On this principle, the utilisation of natural water-power is obviously to the public advantage. When mechanical or electrical energy is generated by the burning of coal, it is a matter of the consumption, not of interest, but of capital. On the other hand, every water horse-power that is put to use is something added, mundanely speaking, for all time, to the permanent resources of mankind.

## TESTING OF ALTERNATE CURRENT MOTORS BY CONTINUOUS CURRENT.

By WILLIAM CRAMP, A.M.I.E.E.

*(Abstract.—Section G, August 24th.)*

SINCE an alternating magnetic field may be resolved into two equal rotating fields, each of 0·7 times the value of the original field, it follows that there is a close connection between the behaviour of an alternate current motor on its normal supply and that of the same motor having the stator supplied with a continuous current of the proper value, while the rotor is driven round at the proper speed by some independent means.

As an example of this consider a repulsion motor. It may be shown that such a motor is a special case of the single-phase alternator, whence the laws governing the value and phase of its rotor current are perfectly well known.

If the motor is arranged so that its stator may be excited with a continuous current, equal to 1·41 A cos 2 $d$ amperes (where A is the normal magnetising current of the motor, $d$ the angle between the brush line and the polar axis) and the rotor is arranged to be driven by a continuous-current motor, then the following tests may be performed.

I.—Calibrate the C.C. motor so that the power required to drive it at any particular speed is known.

II.—Connect it to the A.C. motor shaft (the A.C. motor not being excited), and measure the power required at various speeds; (friction and windage).

III.—Drive as above (in II.) but with the rotor on open circuit, and stator excited with continuous current as explained above. (Rotor hysteresis and eddy losses, hence also stator hysteresis and eddy loss.)

IV.—Close the rotor circuit by connections which revolve with the rotor, and excite (as in III.), and run at what would be synchronous speed. This gives the rotor current at standstill (if desired, for various values of $d$). It also gives, if the speed is varied, the rotor power factor at standstill; a most important point.

V.—With the same continuous current the resistance of rotor and stator may be measured.

Thus all the losses of the motor are completely known, as well as the rotor current and power factor, and the performance of the motor may be predicted exactly.

The method enables a very satisfactory test to be made, when alternating current of the right voltage and frequency is not available, which is an important point, especially in England, where the frequencies are so varied as to make it necessary to have a great deal of apparatus to test even a moderate run of motors. *No wattmeter is necessary*, which is another advantage, and in technical colleges it will be found that students will grasp the working of alternate current apparatus in general, if such methods are used to bring home the close connection which exists between it and similar direct current machinery.

## THE ELECTRICAL CONDUCTIVITY OF CERTAIN ALUMINIUM ALLOYS AS AFFECTED BY EXPOSURE TO LONDON ATMOSPHERE, AND A NOTE ON THEIR MICRO-STRUCTURE.

By ERNEST WILSON, Professor of Electrical Engineering, King's College, London.

*(Read in Section G, August 24th.)*

THE physical properties of certain light aluminium alloys have formed the subject of communications,* and, as stated therein, a specimen of each alloy was placed on the roof of King's College, London, in order to investigate the effect of exposure to London atmosphere. The specimens are in the form of wire 0·126 in. (3·2 mm.) diameter, and were placed on the roof on June 11th, 1901. They have been taken down in July of each of the years 1902-3-4, and their electrical resistance measured. The results are set forth in the table.

It was shown that during the first two years' exposure the series of copper-aluminium alloys (Nos. 16, 4, 13, 14, 15) diminished conductivity to a greater extent the greater the percentage of copper. It will be seen that this process has progressed still further, but the yearly variation is not now so great as during the first year. This last year's exposure still confirms the conclusion previously arrived at that copper alone should not be used in fairly large quantities when alloyed with aluminium to be exposed to London atmosphere. Of the nickel-copper-iron-aluminium alloys (Nos. 20, 21) the former (No. 20) has changed comparatively little, and it is richer in nickel; the latter (No. 21) is richer in iron and shows a gradually increased rate of deterioration. Each of these alloys has a comparatively high tensile strength. The nickel-copper-aluminium alloy (No. 22) which showed such remarkably increased tensile strength as compared with good commercial aluminium has now (like No. 21) considerably diminished total conductivity. On the other hand, the manganese-copper-aluminium alloys (Nos. 10, 9, 23) have suffered comparatively small diminution in conductivity, and No. 23 has a comparatively high breaking load. The iron-copper-aluminium alloy (No. 24) has also shown little change in conductivity during the three years' exposure, and its breaking load is considerably higher than that of good commercial aluminium. The alloy No. 17 has suffered small diminution in electrical conductivity.

It was thought that an examination of the structure of these alloys by aid of micro-photography might throw some light upon the great difference which exists between some of their physical properties. Alloy No. 22 has a breaking load of 45,900 lbs. per sq. in., as compared with about 28,000 lbs. per sq. in. for ordinary drawn commercial aluminium. After grinding and etching with various solutions, practically no structure could be discovered under a magnification of 800 diameters. Considering the remarkable crystalline structure exhibited by ordinary commercial aluminium near the surface of an ingot when allowed to solidify at an ordinary rate, the want of structure in these alloys may be attributed to the process of drawing down. The inference is that the great difference which exists between their tensile strengths and other qualities is probably not due to variation in structure.

I am indebted to the Council of the Royal Society for a portion of the Government grant, which has enabled me to carry out these experiments in micro-photography, and I wish to acknowledge the help I have received from Mr. R. E. Shawcross.

| No. of specimen. | Analysis. | | | | | | Specific resistance in $10^{-6}$ ohm at 15° C. before exposure in 1901. | Percentage variation of electrical resistance at 15° C. | | | | Breaking load in lbs. per sq. in. of cross section. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Si. | Fe. | Cu. | Ni. | Mn. | Zn. | | During 1901-2, taken on value in 1101. | During 1902-3, taken on value in 1902. | During 1903-4, taken on value in 1903. | During 1901-4, taken on value in 1901. | |
| 16 | 0·31 | 0·37 | 0·11 | ... | ... | ... | 2·92 | 1·04 | 0·65 | -0 18 | 1 50 | 26,600 |
| 4 | 0 38 | 0·25 | 0·16 | ... | ... | ... | 2·88 | 1·86 | 1 10 | 1 81 | 4·83 | 25,700 |
| 13 | 0·38 | 0·25 | 1·58 | ... | ... | ... | 3·34 | 3·49 | 1 79 | 0·88 | 6 25 | 39,000 |
| 14 | 0·40 | 0·31 | 1·86 | ... | ... | ... | 3 25 | 5 24 | 1·52 | 1 00 | 7·91 | 40,600 |
| 15 | 0·40 | 0·40 | 2·61 | ... | ... | ... | 3 34 | 7 20 | 2 77 | 3 06 | 11 51 | 43 500 |
| 1 | 0·38 | 0·22 | 0·17 | ... | ... | 0·62 | 2·86 | 3·54 | 1·05 | 2·34 | 7 07 | 28,100 |
| 2 | 0·43 | 0·28 | 0·30 | ... | ... | 1·20 | 2 94 | 2·67 | 3·03 | 0·00 | 5·84 | 30,500 |
| 5 | 0·43 | 0·39 | 0·09 | ... | ... | 2·04 | 3·07 | 2 33 | 1·14 | 0·70 | 4·21 | 26,000 |
| 7 | 0 37 | 0·25 | 0·05 | 0 75 | ... | ... | 3·05 | 1·22 | 0 73 | 1·68 | 3 66 | 29,700 |
| 8 | 0·35 | 0·29 | 0·09 | 1 19 | ... | ... | 3·24 | 2·10 | 0·11 | 2 05 | 4 28 | 33,700 |
| 20 | 0·37 | 1·10 | 0·06 | 2 25 | ... | ... | 3·18 | 1·55 | 0 23 | 0·27 | 2 05 | 38,600 |
| 24 | 0·35 | 1·16 | 0·09 | ... | ... | ... | 2·97 | 0·765 | 0·76 | 0·15 | 1·68 | 31,300 |
| 3 | 0·37 | 0·28 | 0·59 | ... | ... | 0 59 | 3·06 | 2·52 | 0 82 | 1·28 | 4 67 | 30,500 |
| 6 | 0·39 | 0 31 | 0·63 | ... | ... | 1·20 | 3·12 | 2·02 | 0·12 | 1·41 | 3·58 | 30,900 |
| 17 | 0·35 | 0·53 | 0·10 | 0·83 | ... | 0 90 | 3·03 | 0·63 | 0·50 | 0·72 | 1 89 | 31,700 |
| 12 | 0·31 | 0·59 | 0·19 | 1·09 | ... | 0 73 | 3 33 | 1·26 | 1·02 | 0·00· | 2·24 | 31,700 |
| 18 | 0·43 | 0 40 | 0·21 | 1·13 | ... | 1·94 | 3·24 | 2·29 | 1·07 | 0 75 | 4 14 | 34,500 |
| 19 | 0·35 | 0·29 | 0·11 | 2 01 | ... | 1·77 | 3·26 | 2·60 | 0·81 | 1 81 | 5 31 | 36,200 |
| 11 | 0·39 | 0 56 | 0·24 | 2 31 | ... | 0·38 | 3·48 | 1·95 | 0 425 | 1·90 | 4·31 | 34,500 |
| 22 | 0 37 | 0 43 | 1 08 | 1·29 | ... | ... | 3·41 | -1·42 | 3·96 | 4 30 | 6 90 | 45,900 |
| 21 | 0·39 | 2·57 | 0·10 | 1·39 | ... | ... | 3 24 | -0·97 | 3 28 | 7·14 | 9·50 | 42,200 |
| 10 | 0·32 | 0·54 | 0·02 | ... | 0·05 | ... | 3·09 | 0·783 | 0 31 | 1·02 | 2·12 | 29,000 |
| 9 | 0·31 | 0·35 | 0·03 | ... | 0·35 | ... | 3·30 | 1·94 | -0·55 | 0·92 | 2·31 | 30,500 |
| 23 | 0·44 | 0·56 | 0·09 | ... | 1·78 | ... | 3·49 | 2·34 | 0·00 | 0·37 | 2·71 | 35,300 |
| Al* | 0·14 | 0·31 | ... | ... | ... | ... | 2·76 | not exposed | 2·70 | 0·87 | 3 58† | 28,200 |

* Commercial aluminium. † Taken on value in 1902.

## THE PROPAGATION OF ELECTRIC WAVES ALONG SPIRAL WIRES AND ON AN APPLIANCE FOR MEASURING THE LENGTH OF WAVES USED IN WIRELESS TELEGRAPHY.

By J. A. FLEMING, M.A., D.Sc., F.R.S.

*(Abstract.—Read in Section A, August 24th.)*

THIS paper is concerned with an experimental and theoretical treatment of the propagation of electric waves along spiral wires.

The subject has engaged the attention of several physicists. Hertz has described an experiment in which he established stationary electric waves on a spiral wire, and compared the distance of the nodes with the corresponding distances when the wire was stretched out straight.

Theoretical treatment has been given by H. C. Pocklington, and G. Siebt has devised lecture apparatus for exhibiting the propagation of stationary waves on spiral wires.

The first experiments described by the author were made with a long helix of insulated copper wire, wound in one layer on a wooden rod. The helix consisted of 5,000 turns, the length being 200 centimetres. If such a helix is placed in connection with an oscillating circuit consisting of a condenser or Leyden jar, a spark-

* See *Journal* Institution of Electrical Engineers, 1902, Part 154, Vol. XXXI.; British Association Reports, 1901, 1902, 1903; the *Electrician*, Vol. XLVIII., pp. 387, 389, Vol. XLIX., p. 868, and Vol. LI., p. 898; also *Journal* of Society of Arts, December 13th, 1901.

gap and a variable inductance, stationary waves could be set up on the helix by adjusting the inductance in the oscillating circuit. In order to detect the nodes and antinodes of these stationary oscillations, the author makes use of a vacuum tube similar to that used in spectrum analysis, preferably one filled with the rare gas, Neon, which was kindly supplied to him by Sir William Ramsay. Rarefied Neon seems to be extremely sensitive to the presence of variable electric force through it; hence, if such a tube is held perpendicular to the helix, and moved parallel to itself along it, it glows brightly at the antinodes, but not at the nodes. In this manner the internodal distances can be measured with considerable accuracy, and the wave-length of the stationary oscillation measured.

The paper also contains a theoretical analysis of the phenomena leading to the conclusion that the velocity with which the wave is propagated along the spiral, is inversely proportional to the square root of the product of the capacity and inductance of the helix, per unit of length. The author has perfected of late years methods for measuring very small capacities and inductances, and in the case of the above-named helix the inductance is equal to 100,000 centimetres per centimetre, whilst a capacity of the helix is $\frac{7}{10}$ of a micro-microfarad. (1 micro-microfarad = $10^{-6}$ microfarad.)

From these data the velocity of propagation of electric waves along the helix can be shown to be 235,000,000 centimetres per second. This figure is confirmed in the following manner: The capacity and the inductance in the oscillating circuit are both measured when the first harmonic oscillation is formed on the helix, and under those conditions the half wave-length was found to be 140 centimetres, whilst the frequency in the oscillating circuit, as calculated from the capacity and inductance, was found to be $0{\cdot}847 \times 10^6$.

Having, therefore, the wave-length and frequency, we find their product gives a velocity of 235,000,000 centimetres per second, which agrees with the figure determined from the constants of the helix.

It is shown in the paper that the best form of inductance to be employed in connection with the oscillating circuit is a square of one turn of wire, and that the employment of spiral coils leads to errors due to passage of a dielectric current from coil to coil. On the above lines, an apparatus has been devised by the author for measuring wave-lengths in connection with Hertzian wave wireless telegraphy. It is a matter of considerable importance to be able to determine the frequency and wave-length of the waves sent out by any given transmitting arrangement.

The author calls this instrument a "Kummeter." It is constructed as follows:—A long ebonite rod is wound closely with silk-covered wire in one layer, and this is supported on insulating stands. On this long helix slides a metal saddle having some layers of tinfoil interposed, to make good contact between the saddle and the helix. This saddle is connected by a flexible wire with the earth. One end of the helix is furnished with an insulated metal plate, which is placed in apposition to another metal plate connected to the oscillating circuit of the transmitter. The process of measuring the wave consists in sliding the saddle along until a Neon vacuum tube indicates the presence of one node halfway between the saddle and the plate. When this is the case, the distance from saddle to plate is one wave-length of the stationary wave on the helix.

From the constants of the helix, the velocity of the wave along it can be calculated as above shown, and hence the frequency of the oscillating circuit becomes known. If this frequency is divided into the velocity of light, reckoned in feet, it gives the wave-length in feet of the wave radiated from the associated aerial, provided that the aerial radiating wire has been tuned to be in resonance with this oscillating circuit.

This instrument also provides the means of measuring small inductances, and also the frequencies in oscillating circuits, which are much higher than those which can be determined by photographing the spark.

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## SOME POINTS IN REGARD TO THE ELECTRICAL AND MAGNETIC PROPERTIES OF NICKEL WIRE AND FOIL AT HIGH TEMPERATURES.

By Prof. C. G. Knott.

(*Abstract, Section A, August 24th.*)

The main object of the investigation is to find how the change of electrical resistance due to the application of magnetic force, is affected by change of temperature. The magnetic forces are applied both parallel to and perpendicular to the lines along which the resistance is measured. The effect of transverse magnetisation on the resistance of nickel wire is inappreciable in fields lower than 500; but in nickel foil coiled like a tape measure and set in a magnetising field, the effect is easily measured in low fields. The width of the foil in the direction of magnetisation has a distinct influence upon the magnitude of the resistance change in given low fields, being greater for the greater width; but in fields of 50 and higher the narrow foil behaves as effectively as the wider, the effect reaching a distinct maximum, about 1·2 per cent, as the magnetisation in the foil approaches saturation. Practically the same maximum is obtained with nickel wire in a field of 8,000.

At a temperature of about 340° C. nickel losses its characteristic magnetic properties, and the effect of magnetisation upon resistance practically vanishes. But just before it vanishes the numerical value of the change of resistance in a given field undergoes a sudden increase, and then rapidly falls off to zero as the critical temperature is approached. If for a given applied field a curve is drawn with temperature as abscissa and resistance change per unit resistance as ordinate, the curve shows an abrupt minimum at about 290°, and a still more abrupt maximum at 320°. These results are for the wire; a similar effect, though not so pronounced, is obtained with the foil.

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## RECEIVER DROP IN COMPOUND ENGINES.

In arranging compound engines, practical steam engineers have long doubted the value of a variable cut-off to the second cylinder, or even to the first cylinder where the load is steady.

As to the second cylinder, a fixed cut-off at about $\frac{7}{16}$ths of the stroke seems to be as satisfactory a general ratio as anything. The question of receiver drop in compound engines is a perennial source of joy to the student. In Mr. J. W. Hayward's paper on the subject, read before the British Association, Section G, on August 23rd, four tests are described upon an engine. Every test had identical conditions as nearly as possible, except the low-pressure cut-off, which was varied from a mean of 0·3 to 0·4, 0·5 and 0·6 of the stroke. With these four points, the mechanical efficiency of the engine was measured to 80, 84, 82, 83 per cent., and the steam per B.H.P.-hour was 22·8, 22·6, 24·0 and 23·9 lbs. Thus, if anything, the 0·4 cut-off appears best, but it should be noted that the four steam pressures were 99·6, 100·2, 94·0, 98·0, so that, after all, as is usual in such tests, there was a good deal of indeterminateness; and we are left very much as we were, to fix the low-pressure cut-off at 0·4 to 0·5 as usual. The paper reveals other uncertainties which vitiate any conclusions that might be drawn.

The author draws from the tests the conclusion that Prof. Reighton is wrong in fixing on 0·46 as the best point of cut-off, whereas these four tests show 0·3, and not later. This conclusion is rather a big thing to draw from four experiments carried out under admittedly different conditions. It is, of course, very difficult to secure exactly even conditions for such tests, for all the results are so much alike that the conclusion drawn by a practical man would probably be that the cut-off might be anywhere within the limits of the tests made, and in any future work of this kind that may be undertaken by the author, we would suggest to him that he should try to obtain a low-pressure cut-off at 0·1 and 0·9, and note the results. There would be wider differences to observe, and the conclusions would be more reliable.

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## AN ELECTRICAL TEMPERATURE ALARM.

Prof. H. Darwin, in Section G, described an electrical temperature alarm which he had invented. By the use of a diagram on the blackboard, the Professor explained the principle of the Wheatstone bridge, and showed how, by increasing the resistance in the circuit of the bridge, the current could be caused to pass through a galvanometer in connection with the bridge. This was the principle which he had applied when constructing his electrical temperature alarm. In the apparatus, which was of simple construction, platinum was introduced at a particular part of a circuit. On the temperature of the platinum rising from any cause, the current was diverted, and made to pass through a galvanometer. By this divergence a light and delicately poised rod, or "boom," was caused to move and set a bell ringing, an alarm being given by this means.

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## THE PRODUCTION OF MAGNETIC ALLOYS FROM NON-MAGNETIC METALS.

By R. A. Hadfield.

(*Read in Section G, August 23rd.*)

Having for some years produced a non-magnetic iron alloy known as "manganese steel," the author was much interested in learning that with the same metal, manganese, which had enabled him to obtain a practically non-magnetic iron alloy, it had been found possible to produce a magnetic copper alloy. Dr. F. Heusler had given him much interesting information. The author had also produced some of the alloy. It was well known that the metals copper, aluminium, and manganese were non-magnetic. It was, therefore, surprising to find that combined in certain proportions they produced an alloy having considerable magnetic properties. No combination of copper with aluminum produces a magnetic alloy. The peculiar change noticed, therefore, must be ascribed entirely to the presence of metal manganese, the same metal which in manganese steel, produced the profound change in iron, converting it from its well-known magnetic to a non-magnetic condition. As it was thought that perhaps the metal manganese, under certain conditions, might show some reversibility, as is the case with certain iron-nickel alloys, which, whilst being non-magnetic at ordinary temperatures, become magnetic at low temperatures—60° to 80° C. Sir James Dewar submitted the manganese metal which the author used in producing the alloy exhibited to the Section, to the temperature of liquid air. No change was found to occur; the metal remained as non-magnetic as at ordinary temperatures. This, under the same test, was found to be the case with the copper and aluminium used in his experiments. The alloy exhibited, contained 60 per cent. copper, 25 to 27 per cent. manganese, and 12 per cent. of aluminium. The manganese metal contained about 92 per cent. of manganese, the rest being 6 to 7 per cent. of silicon, ·5 to 1 per cent. of carbon, and probably 0·50 per cent. of iron. But Dr. Heusler had shown that, with absolutely no iron present, the magnetic qualities were exactly the same. Another very curious point was, that, whilst it must be the manganese which conferred

the magnetic properties, the "reversibility," so to speak, was brought about by the aluminium.

For example, with the manganese fairly constant, 25 to 28 per cent., and the aluminium varying from 3 to 14 per cent., the magnetic stability with 3 per cent. was nil; 5 per cent. conferred a little; 10 per cent. gave still more, the maximum being reached with 10 per cent. aluminium.

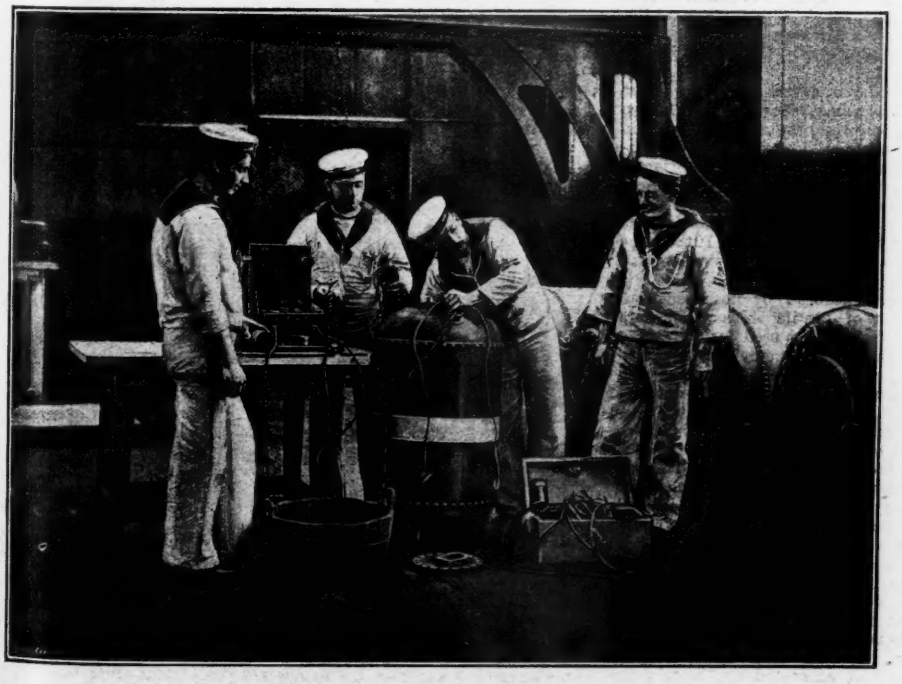
| Specimen number. | Analysis per cent. | | H (magnetising force). 20 | 40 | 100 | 150 |
|---|---|---|---|---|---|---|
| | Mn. | Al. | B equals magnetic induction. | | | |
| 34 | 28 | 3·6 | Unmagnetisable. | | | |
| 35 | 28 | 5·7 | Very slightly magnetisable. | | | |
| 36 | 26 | 9·6 | 2,220 | 2,670 | 3,200 | 3,470 |
| 32 | 26 | 14 6 | 4,500 | 4,850 | 5,380 | 5,550 |
| 33 | 25 | 13·8 | 3,580 | 4,075 | 4,645 | 4,900 |

Dr. Heusler stated that the magnetisability of the alloy will increase with an increased percentage of aluminium, the maximum for any stated percentage of the manganese being attained when the aluminium percentage amounts to roughly one-half of the per cent. of manganese, or, in other words, when the alloy contains one atom of aluminium to one atom of manganese. The alloy exhibited was, unfortunately, very brittle, and all attempts to forge it cold or hot at various temperatures even only at dull red, had been unsuccessful.

## ELECTRICALLY-OPERATED SUBMARINE MINES.*

By WALDON FAWCETT.

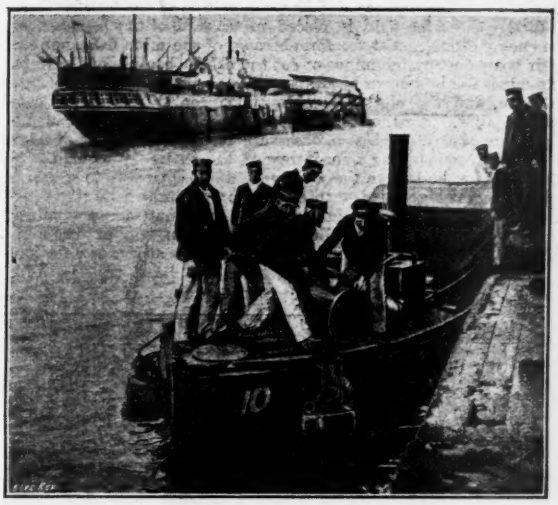
The extensive employment of submarine mines in the war in the Far East, and the repeated demonstrations of their deadly effectiveness, have served to direct considerable attention to this very important class of war utilities. Electricians have reason to feel an especial interest in the subject, not only because the major portion of the mines used in the struggle in the Orient and in other recent conflicts are electrically operated, but also by reason of the fact that the future development of mines for harbour defence is largely dependent upon electrical science.



Fitting up an Electrically-Operated Mine on H M S *Vernon*.

Indeed, the present achievements of this very extensive and important branch of naval warfare have been rendered possible only by the introduction of electricity and high explosives. In the mind of the uninitiated, submarine mines of all kinds are, as a rule, inevitably associated with torpedoes, but, as a matter of fact, they constitute a much more recent development. The first recorded destruction of a ship by a torpedo dates back to the beginning of the last century, when Fulton managed to sink a small vessel experimentally by affixing a charge to her hull by means of a submarine boat.

It was not, however, until the Russian war that mines were seriously tried in actual warfare. As employed by the Czar's engineers in the defence of the Baltic ports during that war, they did not prove wholly successful, but, nevertheless, two British men-



Loading Electrically Controlled Submarine Mines, Preparatory to Mining a Harbour.

of-war, the *Merlin* and *Firefly*, were badly shaken up by the explosion of these initial mines. These early Russian mines, it should be explained, were of the type known as the "mechanical"—that is, they carried their own means of firing, and were independent of any outside agency such as electricity. Modifications of these mines are in use to some extent to this day.

In naval and military circles to-day, however, these mechanical mines are generally regarded as makeshifts, which are undesirable for the obvious reason that they are equally dangerous to friend and foe, and which should only be employed when peculiar conditions render impracticable the utilisation of the electrical mine with its paraphernalia of cables and batteries. The electrical mine, which is so vastly superior to every other similar agent of destruction, was first used in the Civil War. The electrical mines, or "ground mines," as they are sometimes designated, are of very simple construction, and are fired by means of an electric current from the shore.

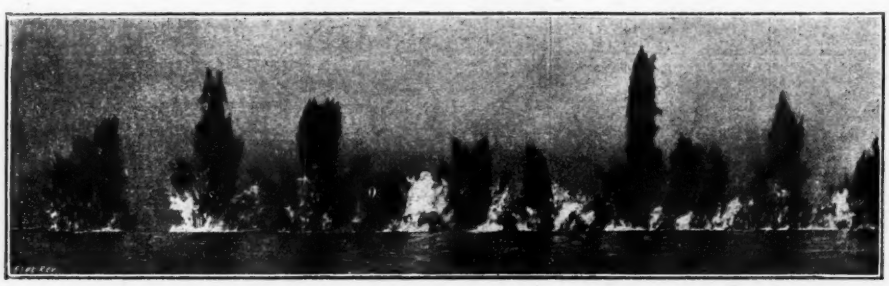
A representative electrical mine consists primarily of a buoyant iron case containing a charge varying with circumstances from 200 lbs. of gunpowder up to as much as 700 or 800 lbs. of guncotton. Gunpowder was used almost exclusively in the earlier electrical mines, but it has been almost wholly superseded by guncotton or other high explosive for the reason that the latter is more powerful and is not affected by dampness. Indeed, guncotton is generally used in a wet condition.

The fuse for firing is a very simple affair, consisting of a cylinder 2 or 3 in. long, containing a little fine powder at the big end while the small end is filled with fulminate of mercury which is a tremendously powerful detonator. Through the ebonite head are led two thick copper wires which are connected together inside the fine grain powder by a very thin platinum-silver wire. The electrical battery on shore is connected to one of the thick copper wires of the fuse by a special cable which is led into the mine by a watertight joint. When it is desired to fire the mine, a firing key in the circuit is pressed and a current of electricity sent along the cable. It flows easily along the thick copper core, and on to the copper

* New York *Electrical Review*.

wire of the fuse, where it is then checked by the piece of thin platinum-silver wire which rises to a red heat. This naturally ignites the surrounding powder and fires the mine.

The mining of harbours with such a system of electrical defence constitutes one of the most highly specialised functions of our military and naval administration. In the first place, the selection of a position for an electrical mine field must be made with reference to the shape of the harbour and the disposition of the fortifications. Naturally the mine field is placed to seaward of the forts so that the enemy cannot get at the forts because of the mine field, nor can their boats destroy the mines or cut the cables because of the forts. The mines are laid down by boats, either singly or in groups of two or three, and the electrical cables taken on shore to some convenient point. For the operation of the mines to the best advantage there are selected two observation stations, located at high points and commanding a good view of the entire mine field. As the mines are laid down the observers at these two stations, which are located at right angles to each other, carefully note the exact position of each mine as laid and record it by putting up a pair of pickets in that direction. In this way the position of any mine can be accurately determined by the operators at the two stations



Effect of Countermining with Electrically Controlled Submarine Mines.

observing together. The electrical circuit is then joined up, there being a distinct circuit for each mine or group of mines, and the two operating or observing stations are further connected by telephone or telegraph or both.

Under war conditions operators are constantly on duty at both stations, and should a hostile ship approach the mine field close watch is kept, and as the vessel passes over each line of mine pickets the corresponding firing keys for the mine or mines at that point are pressed. Obviously if an enemy's ship passes over the intersection of two lines of vision from the respective stations the two operators will press the keys simultaneously, the circuit will be completed and the mine fired.

This outline, it should be pointed out, covers nearly the most simple plan of operation for electrical mines. Several nations have of late years adopted systems which while far more elaborate in themselves require but a single observer or operator. The elaboration of the new systems consists primarily of the introduction of more complicated arrangements and delicate instruments for testing and firing the mines. Some of the mines, for instance, are connected with the firing station by telephone, and so long as they are in good working order can be made to buzz like a bee. If the mine fails to respond to its call it is known that something is wrong, and it must be raised for inspection.

The use of mines or stationary torpedoes is by no means confined, however, to the destruction of hostile ships which are attempting to enter a harbour. Mines are also used for destroying other mines and may be placed outside an enemy's port so as to make it dangerous for him to venture out. In the latter case they are called blockade mines, whereas when they are used for destroying other mines they are designated as counter-mines.

The destructive area of an electrically operated submarine mine—also known as a ground mine or observation mine—has been found by experiment to be the area embraced by a circle on the surface of 30 ft. radius, so that allowing 60 ft. for the breadth of the ship, the mines would be placed across the ordinary mined channel at intervals of 120 ft. By introducing several lines of these mines a channel or harbour can be most completely mined. Mines give the best explosive effect when placed at a depth of about 50 ft.

Under the latest approved system the operator or observer times the firing of the mines by looking through the telescope of an instrument, on the platform of which is a plan of the mine field with small metal studs representing the danger area of the various mines. From these studs the electrical wires lead to the mines which they represent. To the telescope itself is connected the battery for producing the electricity. Keeping the centre of the telescope following the enemy's ship, it will be appreciated that when the hostile vessel crosses the danger area of a mine, the movement of the telescope will have brought the battery into connection with the stud representing the mine, and the electricity flows through, so firing the mine. Electrical mines are the only ones which are suitable for use in channels which must be kept open for the ingress and egress of friendly ships, as they are under complete control from the shore, and being placed at considerable depths there is little danger of ships colliding with them.

Counter-mining, in which electricity is also the agent employed, is seldom practicable owing to the impossibility of carrying out the work under gun fire which would almost inevitably be necessary under war conditions. It is obvious, however, that since a 500-lb. mine—that is, a mine containing 500 lbs. of gun-cotton—will destroy all the mines within a radius of 90 ft., 12 of these mines, such as can be transported at one time in an ordinary ship's launch, will, if properly laid 180 ft. apart, clear by their explosion a channel 60 yards wide and 720 yards in length.

In many navies, notably the American and British, increased attention is being given to the instruction of regular classes of officers and men in torpedo and submarine mine work and in the schools at Newport, R.I., and on his Majesty's ship *Vernon* (stationed at Portsmouth, England), the young mine experts are well grounded in a thorough knowledge of electrical science.

## POWER-FACTOR METER CONNECTIONS*

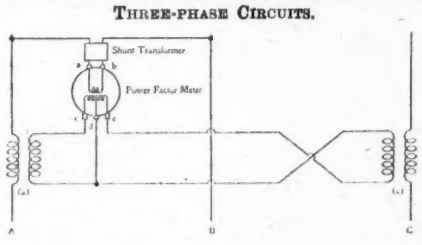
The usual way to connect a power-factor meter to a three-phase circuit is shown in the diagram, fig. 1.

A, B and C are the three phases of the three-phase circuit. Only two series transformers, A and C, are necessary. The shunt transformer may, or may not, be necessary, according to the potential between A and B.

Leads *c*, *d* and *e* are connected to what is virtually a two-phase induction motor in the interior of the power-factor meter. It is this motor that, partially counterbalanced by the shunt coil in the interior of the meter, gives torque to the dial pointer. There is no electrical connection between the shunt coil and the motor, so that while current flows readily from *c* to *d* and from *d* to *e*, no current can flow from either *c*, *d* or *e* to either *a* or *b*. Finally, it is important to note that the current in *d* is the vectorial sum of those in phases A and C.

By placing an ammeter in *d* and by arranging two additional shunt circuits on each side in such a way as to be able to short-circuit the ammeter at will, the current in each of the three phases may be measured by the ammeter with the aid of four ammeter plugs.

Fig. 1.—Usual Connections of Power-factor Meter in Three-phase Circuits.



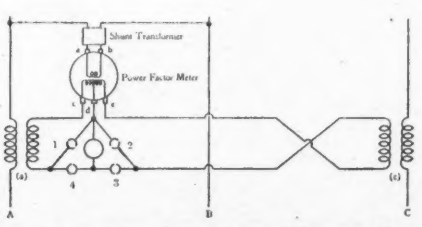




Fig. 2.—Connections of Power-factor Meter in combination with Ammeter.

Thus in the diagram, fig. 2, by plugging in 1 and 2 the current from phase C is shunted away from the ammeter—although still allowed to pass to *d* and thence to the power-factor meter—and the current from phase A passes through plug 2, and may be read in the ammeter on its way to the power-factor meter. Therefore, by this arrangement, we obtain the current in phase A and also the power-factor of the combined circuit.

By plugging in 2 and 3, the currents from both phase A and phase C pass through the ammeter—which registers their vectorial sum, which is equal to that in phase B—and from thence into the power-factor meter. Thus, by this arrangement, we obtain the value of the current in phase B, and also the power-factor.

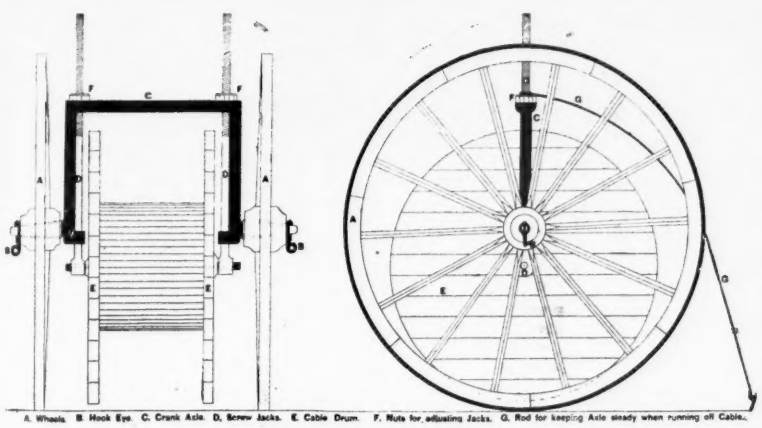
By plugging in 3 and 4 the current in phase A is shunted away from the ammeter—although still allowed to pass to the power-factor meter—and the current from phase C passing through 3 is measured in the ammeter without disturbing the power-factor meter reading.

* *Electric Club Journal*, Pittsburg, July, 1904.

Finally, the ammeter may be disconnected entirely by plugging in 1 and 4 only. This is a safe and convenient way to leave the plugs when not in use. Care should be taken not to pull both 1 and 3 or both 2 and 4 out at the same time, as by so doing the secondary of transformer *a*, or that of transformer *c*, will be open-circuited, in which case the primary current will saturate the core, inducing a dangerous secondary voltage.

## A NEW CABLE-DRUM CARRIAGE.

THE cost of, and loss of time involved in, the handling of heavy cable during laying is often greater than one would imagine. For instance, it will be found that a drum of cable weighing 3½ tons will waste two hours, and will cost quite 5s. for every 500 yards it is pushed along a good level and fairly straight road. Should there be many turnings or gradients by the way, the cost will, of course, be greater. The reason for this is obvious when one notes the construction of the clumsy cable drum with its wooden and battered edge. Then again there is great danger in pushing a drum to many jobs, as when such a clumsy affair, weighing 4 tons or thereabouts, "takes charge" down a hill, the trouble does not end with long columns in the local papers giving the list of casualties and asking nasty questions. More than one company and corporation know this from experience. Up till now, however, the only alternative to the above method was the cumbersome four-wheeled drum carriage necessitating the use of a horse. Taking into consideration the first cost, horse charges, &c., the latter method is almost as costly as the former; nor is this a handy vehicle on account of its length, stay bar, &c., to run cable off. As a matter of fact, it is hardly ever used, except for the carting of cable.



A. Wheels. B. Hook Eye. C. Crank Axle. D. Screw Jacks. E. Cable Drum. F. Nuts for adjusting Jacks. G. Rod for keeping Axle steady when running off Cable.

NEW TYPE OF CABLE-DRUM CARRIAGE.

The custom of the National Telephone Co. in Glasgow is to mount their drums (which do not vary much in diameter) on the axle of two strong wheels. The ease and speed with which they handle and lay heavy telephone cables in the busy streets of Glasgow clearly shows the handiness and many advantages of the two-wheeled drum carriage. In mounting the drum in the above way, *i.e.*, on a *straight* axle between two wheels, it is, of course, necessary to raise the drum, take the wheels off the axle, put the axle through the drum, put the wheels on again and lower! This proceeding takes time, and is in many ways a great disadvantage. Messrs. David Stirrat & Son, coachbuilders, 132-138, Port Dundas Street, Glasgow, are now building a two-wheeled drum carriage shown in the accompanying sketch, which is claimed to combine the advantages of both types of vehicles mentioned, without their disadvantages. The idea of the bent axle was suggested by Mr. A. J. Abraham, the chief assistant and mains superintendent, Partick, but the carriage is designed by Messrs. Stirrat and Son, who have had a good deal of experience in the building of such vehicles.

## SIMPLE STORIES.

BY "INNOCENS."

### VII.—LOCAL INTELLIGENCE.

NOTE.—The Middlesbrough Electric Light Committee recently held an inquiry into the inclusion of an item for "milk" in the station costs. The engineer explained that this was the cost of upkeep of a harmless, necessary cat on the station.

AT a meeting of the Electric Light Committee of Centreburgh, held on the ——th inst.,

COUNCILLOR MONEYBAGUE drew attention to the charge of seven shillings and sevenpence in the last quarter's account under the item "milk," and said that it was the usual custom for the Resident Engineer to a Lighting Scheme to defray the expense of his matutinal lacteal fluid from the salary paid him by the Committee.

The CHAIRMAN called on the Borough Electrical Engineer for an immediate elucidation.

The BOROUGH ELECTRICAL ENGINEER explained that, unfortunately, it had been found that certain mice who had taken up their residence in the electric light station had exhibited a *penchant* for sitting on the high-tension bus-bars. Although this practice was in itself harmless and amusing, it detracted from the business-like aspect of the place, and had the additional disadvantage that the mice, in following their usual habit of dangling their tails, caused either partial or complete short-circuits, thereby occasioning themselves much inconvenience, and rendering the voltage regulation a matter of some difficulty. Temporary measures—such as providing the volt-boy with a long bamboo rod, and giving him instructions to swipe at any mouse within range—having proved ineffective, he had come to the conclusion that the only thing to do was to appoint a cat to the post of Mouser to the Electric Light Committee. The initial expense had not been great — in fact, he got the beast for nothing — and the additional revenue charge worked out at 0·0000067d. per unit delivered at consumers' terminals.

COUNCILLOR TECKNEEK asked whether adequate measures had been taken to instruct the Mouser to the Electric Light Committee as to the dangerous nature of its calling as regards the possibility of getting high-tension shocks.

The BOROUGH ELECTRICAL ENGINEER replied that the Mouser had unfortunately learned by practical experience that certain parts of the switchboard were unsafe to handle, as she had already received a 2,000-volt shock. A prompt application of the suggestions laid down in the ELECTRICAL REVIEW'S Shock Sheet had, however, resuscitated her, and now she was going about with eight lives still in hand.

COUNCILLOR MONEYBAGUE asked if the Borough Electrical Engineer was aware that interruptions to supply were still distressingly frequent owing to the antics of the mice. On his last visit to the station he had an interesting conversation with the junior oil-boy, who assured him that he had on several occasions seen mice sitting on the synchronising lamps. This pointed to inefficiency on the part of the Mouser.

The BOROUGH ELECTRICAL ENGINEER explained that the Mouser had recently been engaged in rearing a large and interesting selection of junior mousers, and during the past few days had been instructing them in the duties of the office. He hoped, therefore, that in a few weeks, owing to the reinforced staff, interruptions to supply due to mice would be entirely eliminated.

COUNCILLOR MONEYBAGUE protested against a servant of the Corporation delegating her duties to others while in receipt of a salary paid for the performance of such duties.

COUNCILLOR TECKNEEK differed from the previous speaker on the ground that it was the custom for all the higher officials to delegate the bulk of their duties to subordinates, restoring the balance by themselves appropriating the bulk of the salary. This was a well-established and almost universal custom in Corporation concerns.

The CHAIRMAN suggested that the best way to promote efficiency would be to diminish the supply of milk to the Mouser, who would then feel a stronger inducement to provide food by her own exertions.

It was therefore resolved that the amount to be put aside per quarter for the maintenance of the Mouser to the Electric Light Committee be three shillings and ninepence halfpenny, instead of seven shillings and sevenpence as heretofore.

## THE NEW BOARD OF TRADE REGULATIONS.

(*Continued from page* 332.)

The foregoing concessions are of some importance, as they are sure to be taken wide advantage of in connection with the supply of energy for lighting and power to factories, mines, &c. We notice that it is specified that the metallic casing shall be efficiently connected with earth, or otherwise arranged to guard against shock. It would be interesting to have from some authority a clear definition of an efficient connection with earth. No doubt the precautions at present taken in connection with circuits such as described will meet the requirements regarding fuses and switches, but sub-clause (*a*) (5) is certainly a good precaution, although, perhaps, somewhat difficult to enforce.

Clause 2 specifies that the two sides of a three-wire system brought inside a consumer's premises shall be kept quite distinct, and must be connected to two pairs of terminals. The conditions regarding extra high pressure supply are of interest, and are embodied in Clause 3, as follows :—

**3. The pressure of a supply delivered to any consumer's premises shall not exceed the limit of high pressure, except with the consent of the Board of Trade and subject to such regulations as the Board may prescribe, and to the following conditions :—**

**(1) The premises must be a factory, a mine, or electric traction works.**

**(2) Where the premises are a factory, or a mine, the supply shall only be given on condition that the provisions of the Factory Acts and the Mines Regulation Acts, respectively, and any regulations which may be made thereunder, are complied with.**

Possibly these regulations have been made with an eye to the future, as pressures exceeding 3,000 volts are not at present in large demand in the places indicated.

Clause 4 deals with the minimum size of conductors, and is the same as the old Clause 5, but the reservation is wisely made that it does not apply to an electric line in a lamp-post. Clause 5 specifies that the testing pressure for all low and medium pressure mains shall be 50 per cent. greater than the maximum, and at least 200 volts; the former point is additional to old Clause 7. Clause 6 regarding the maintenance of insulation stands exactly as old Clause 8, and the same applies to Clauses 7, 8, and 9, which correspond to the old numbers 10, 11 and 12. With regard to transformers, it is now added by Clause 10 that the metallic portion shall be efficiently connected to earth. Clause 11 (old Clause 13), dealing with limit of power in a high pressure line, reads as follows :—

An electric line used for a high pressure supply shall not be used for the transmission of more than 500 KW. (old clause, 300,000 watts), or, in the case of an overhead line, 50 KW. . . .

In the case of the London authorities, the mention of overhead lines is naturally omitted. Clauses 12 and 13 are exactly similar to old Clauses 14 and 15.

This completes Section A, and we find that the following old clauses have been omitted :—Clause 2, dealing with pressure of supply to transforming apparatus; Clause 4, maximum current in conductors; Clause 6, specifications of insulating material; and Clause 9, high pressure conductors to be covered. We think that of these, the last most likely "never will be missed."

*(To be concluded.)*

## NEW PATENTS APPLIED FOR.

**Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.**

17,674. "Improvements in and relating to telephones." S. J. Port. August 15th.

17,707. "Improvements in electrical switches." C. J. Klein. August 15th.

17,733. "Improved suspension fitting for electric motors." G. Davis. August 16th.

17,738. "Improvements in switchboards." I. H. Parsons. August 16th.

17,741. "Alternating current power transmitting apparatus." W. Fairweather. (Arnold Magnetic Clutch Co., United States.) August 16th. (Complete.)

17,752. "Improved magneto-electric generator." R. Ainsworth and P. R. Jackson & Co., Ltd. August 16th.

17,764. "Improved means of regulating electric currents." H. Hill. August 16th.

17,780. "Improvements in travelling carriages for overhead runways." R. Priest and W. Morrall. August 16th.

17,784. "Improvements in or relating to electrolysis cells." E. A. Ashcroft. August 16th.

17,792. "Improvements in and relating to the manufacture of incandescent electric lamps." J. M. Canello. (Date applied for under Patents Act, 1901, September 12th, 1903, being date of application in France.) August 16th. (Complete.)

17,805. "Improvements in or relating to telephone and other conducting cords." T. H. M. Harvey. August 16th.

17,808. "Improvements in electrical measuring instruments." Evershed and Vignoles, Ltd., and S. Evershed. August 16th.

17,809. "Improvements in electric controllers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) August 16th.

17,812. "Improvements in electric fuses." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) August 16th.

17,889. "Improvements in or relating to telemeters." G. Aragno. August 16th.

17,837. "Improvements in terminals for secondary and primary batteries." J. M. Richardson. August 17th.

17,841. "Improvements in electric motors" W. J. Hawkins. August 17th.

17,862 "Improvements in and relating to electrical conductors; specially applicable to overhead conductors for electrical tramways" E. M. Ginders. August 17th.

17,939 "Improvements in electric trolleys." J. Lauvernier. August 18th. (Complete.)

17,975 "Improvements in the control of electrically propelled vehicles." J. S. Raworth. August 18th.

17,978. "Improvements in or relating to suspending or supporting electric motors or differential gear or both, on motor road vehicles or tramway vehicles." G. B. Ellis. (La Société A Vedrine et Cie, France.) August 18th.

17,997. "Improvements in electrical switches." F. F. MacDonald. August 19th.

18,020 "Improvements in electrical driving mechanism for machinery in general." J. R. Hill. August 19th.

18,042. "Improvements in processes of oxidation and reduction effected in an electrolytic bath." O. Imray. (Farbwerke vormals Meister, Lucius and Brüning, Germany.) August 19th.

18,060. "Improvements in electro-mechanical apparatus for automatically operating the rail and electrical conductor points on electric tramways and railways from the tram or train." G. D. A. Parr. August 20th.

18,095. "Improvements relating to telephone switchboard cords and like flexible electric conductors." W. J. Burton and C. L. Burlingham. August 20th. (Complete.)

18,098. "Improvements in and connected with wireless telegraphy and apparatus for carrying out the same." G. C. Dymond. (Gesellschaft für drahtlose Telegraphie m.b.H., Germany) August 20th. (Complete.)

18,087. "Improvements in the transmission and distribution of electric power." J. Kruyswijk. August 20th.

18,101. "A new or improved means of converting alternating current for use with continuous current electrical measuring instruments and the like." W. C. Head. August 20th.

18,105. "Improvements relating to the transformation of repulsion motors when running at speed into rotating field asynchronous motors." M. Latour. (Date applied for under Patents Act 1901, August 27th, 1903, being date of application in France.) August 20th. (Complete.)

## PUBLISHED SPECIFICATIONS.

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Galvanic Curative Appliances for Human Use. F. Tomlinson. 3,276. February 10th.

Telephone and Time Recorders Therefor G. Furst. 113. January 2nd.

Sparking Plugs. P. Duffis. 114. January 2. (Date applied for under Patents Act, 1901, January 7th, 1903, being date of application in France.)

The Equipment of Electrically Propelled Railway Cars. Siemens Bros and Co., Ltd. (Siemens & Halske Aktiengesellschaft, Germany). 193. January 4th.

Electric Conductors for Illuminating Purposes. I. La Goff and J. MacNaughton. 224. January 4th.

Electric Incandescent Lamp. C. C. Regnart. 291. January 5th.

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Electric Accumulator Plate. C. P. Elieson. 1,187. January 16th.

The Production and Manufacture of Pipes or Conduits, or other Articles for use Underground or in other Situations where they are subject to Electrical or Corrosive Action. J. Y. Johnson. (L. A. Brown and D. Tredway, United States.) 1,279. January 18th.

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Thermal-cut-outs for Electric Circuits. W. Fairweather. (American Electric Telephone Co., United States.) 4,450. February 23rd.

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Clockwork Electricity Meters. H. Aron. 2,467. February 1st.

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Vapour Electric Lamps. H. I. Wood. 3,774. February 15th. (Date applied for under Patents Act, 1901, February 14th, 1903, being date of application in United States.)

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